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# ***JPRS Report***

## **Science & Technology**

***Europe/International***

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# Science & Technology

## Europe/International

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4 May 1993

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## ADVANCED MATERIALS

### FRG: Institute Develops Materials From Nanocrystals

93WS0351A Frankfurt/Main FRANKFURTER ALLGEMEINE in German 17 Mar 93 p N2

[Article by Anne Hardy: "Materials from Nanocrystals"]

[Text] When material scientists reduce the size of a material to the point where its diameter is only a few molecular lengths, they are often pleasantly surprised. Ceramics made from these so-called nanoparticles are malleable, metals suddenly behave like insulators, and previously impossible alloys can be made. The discovery of these special properties in the early 1980s first gained the attention of solid-state physicists. Today, chemists, too, are taking an increased interest in these tiny particles, which can scarcely be seen even under an electron microscope. Instead of grinding solid bodies into fine powder particles, they produce the nanoparticles by means of chemical bonding of molecules. Helmut Schmidt of the Saarbrueck Institute for New Materials (INM), working with some 115 colleagues, has been investigating the technical uses of the nanoparticles for some time.

This material researcher came upon the small particles quite accidentally in the mid-1970s. He had been investigating a chemical process at that time, in which dissolved molecules grew into ever larger particle amalgamations. It was precisely then that the mixture in Schmidt's reactor revealed unexpected properties after the particles had grown to a few nanometers (millionth of a millimeter). From that time on, this skilled chemist has been systematically studying the possibilities of this process, which has been designated a sol-gel process.

The Saarbrueck scientist does not think of himself as a real nano-researcher. His work is concentrated more on the interface between theory and practice. The novel concept of this new institute, which Schmidt himself helped develop, made it possible, for the first time, to accompany a material from the fundamental principles of its synthesis to its practical use. This has evoked lively interest among potential users. Just three years after its founding, the Institute for New Materials has already cultivated contacts with renowned German companies, and is even consulting with European, American, and Japanese companies.

The strength of the institute lies in its mastery of the sol-gel process. Whether it is a matter of types of glass, ceramics, or nano-composites, Schmidt applies the process almost across the board. The applications are often astonishingly practical as, for example, bathroom mirrors that do not steam up, dirt-resistant window glass, or scratch-proof coatings for eyeglasses. Should a user approach him with a wish-list for properties in a new material, Schmidt can often turn to already available materials which he need only adapt to the specific

purpose. His priority resource is goal-oriented research that is directed to the needs of the user.

Early in his scientific career, when this now 51-year-old researcher first turned to the sol-gel process, the technology was already three and one-half million years old. Glass-like formations in the Libyan desert attest to that, as do precious stones like agate and opal, which the institute also produces as a lark. However, the process has only been used technically since the late 1980s. At that time, the Schott Company for the first time treated the glass facades of large modern buildings with a coating that reflected light and heat.

The components were dissolved and mixed together for that purpose. The molecules are hydrolyzed with water and then fused together by condensation. When the tiny suspended particles in this so-called sol reach about the size of several nanometers, the reaction is broken off. Owing to the attractive force between the particles, a solid gel grows out of the liquid. In the transition between the liquid and solid phases, the mixture can be poured into the desired form, drawn or processed into a film.

Schmidt used this process for the first time at the Fraunhofer Institute for Silicate Research to bond organic and inorganic components together in a material at the molecular level. As a result, a completely new class of material was developed. The starting point was inorganic silicic-acid ester, which had been modified with an organic side group. The typical silicate network, but with organic functions that could be varied as desired, arose in the sol-gel process. Materials of this sort combine, for example, the optical properties of glass with the mechanical stability of an organic polymer. The versatility of the organically modified ceramics, called Ormocers for short, had in the meantime inspired researchers throughout the world. Today, the technology has advanced to the point where Schmidt can produce "function coatings" out of three or more different components. The most recent example is a coating for glass panes which will make window cleaning unnecessary in the future. When the liquid mixture is applied to a glass plate, the components of the mixture order themselves independently in the desired coating sequence. The most strongly polar components provide the adhesion to the likewise polar glass pane. Owing to their low interfacial energy, the dirt-repellent groups wander to the surface. Finally, the nanometer-fine ceramic particles, which imparts stability to the film and protects it from being rubbed off, remains in the middle.

In the course of his research, Schmidt has repeatedly discovered new variants of the sol-gel process. For example, he has bedded nanoparticles in a plastic network. Since light refraction no longer plays much of a role in the case of such tiny particles, a transparent material develops that can be processed like a plastic. Unlike pure plastics, the optical refractive value of this nanocomposite can be easily adjusted over the fraction

of ceramic particles. This simplifies the use of this material for optical chips, waveguides, and components for integrated optics.

Nanomaterials are therefore not just easier to adapt to their particular function, but are often even cheaper to produce. As a rule, polymers have to be produced in great quantities so that each charge has a chain length as unified as possible to ensure that properties remain the same. The sol-gel process, on the other hand, also permits small amounts of a constant-quality material to be produced at a favorable cost.

If the nanoparticles are not bedded in a matrix, but instead are surrounded by a molecularly thin lubricating coating, they densify quite easily into a solid body. Without this shell, the particles would become entangled with each other because of the strong attractive force. They would form agglomerates and therefore defects. Only at high temperatures does the kinetic pressure of the "ceramic" components become so great, that they are transformed into crystal and are able to form a dense structure of crystal phases. This dense structure imparts to ceramics their typical properties. Because the densification of the material cannot be controlled independent of the crystal growth, the required density is generally only achieved at the price of an irregular, defective structure.

The structure becomes more regular at low sintering temperatures because smaller crystals form then. Nanocrystalline particles even form a dense structure at temperatures several hundred degrees below those of conventional ceramic technologies, without crystals growing. In this way, ceramics can, for the first time, be densified to an almost defect-free component. This structure, relatively free of defects, also remains intact even when the structure is deliberately exposed to higher temperatures.

To be sure, the nanoparticles are also prone to form agglomerates that frustrate all further efforts. Because conventional lubricants, for example, organic polymers, almost reach the size of the ceramic particles, Schmidt uses short-chain molecules. They envelop the 5- to 15-nanometer small particles with a hair-thin film less than one nanometer thick. The fine powder, from which the preliminary state of the eventual component is pressed, achieve an unusually high density in the way. In the case of particles having a diameter of 15 nanometers, the volume of this so-called green body already up to 65 percent ceramic particles. The material is as soft as wax and can be worked like a plastic. Schmidt, therefore, has succeeded for the first time in developing a ceramic process technology.

The lubricant coating consisting of organic molecules has also proved itself with glasses. Schmidt, for example, has already succeeded in producing 10-micrometer-thick films through the use of a unique immersion process. Without this tricky process, the films would tear off when they reached a coating thickness of one micrometer

because the particles would become entangled with each other while the melt cools. In this case, too, the unique properties of nanocrystalline glasses only become usable because they can now be technically processed.

#### France: Super Plastic-Forming Press Developed for Nacelle Manufacture

93WS0412D Paris *LA LETTRE HEBDOMADAIRE DU GIFAS* (supplement to *LE BULLETIN DU GIFAS*) in English 4 Mar 93 p 2

[Text] An SPF/DB (Super Plastic Forming/Diffusion Bonding) press entered service at the Aeronautical Sheet-Metal Unit of HISPANO-SUIZA's Le Havre Center earlier this month. The press is used for making cowlings for SAAB 2000 nacelles. It is one of the largest presses of its type in current service. Major specifications are: maximum temperature 1,000°C; force 1,600 tons; dimensions of plates 2,440 x 1,830 mm, maximum opening 700 mm; maximum gas pressure 50 bars; maximum differential pressure 5 bars. The super plastic forming technique utilizes the capacity of certain titanium alloys, aluminium alloys and nickel base alloys to withstand elongations [as published] of up to 1,000 percent under certain temperature and pressure conditions. Forming operations are carried out through the injection of neutral gas, which serves to press the sheet against a die. With this new press, HISPANO-SUIZA will be able to make complex geometric shapes far more economically. HISPANO-SUIZA's expertise in aeronautical sheet-metal working has already earned the company international recognition (for example, in conjunction with afterburners). The new press is certain to provide a further competitive edge. HISPANO-SUIZA intends to capitalize on its investment to carve out a greater share of the nacelle/thrust-reverser market, especially nozzles and mixers.

#### AEROSPACE

##### French Firms View Russian Competition in Space Launcher Market

###### Russia Joins Launcher Market

93WS0309A Paris *LE FIGARO (LE FIG-ECO SUPPLEMENT)* in French 2 Mar 93 p 2

[Article by Jean-Paul Croize: "Space Launchers: The Competition That Came In from the Cold"; first paragraph is *LE FIGARO* introduction]

[Text] The Russians are marketing all their know-how at firesale prices. But their commercial capabilities are still limited.

Is it time to start fearing Russian rockets again? It is not a new threat of East-West nuclear conflict that prompts the question, but the entry of the former Communist block into the space market. More precisely, its entry into the launch market for civil satellites, essentially

telecommunications (80 percent), but also earth observation, weather, and scientific research satellites.

The threat was brought home by the recently announced agreement between the American aeronautics giant Lockheed and the Russian firm Khrunichev to market—and perhaps improve—the powerful Proton rockets, which until now have been used to launch the former USSR's heaviest space loads.

The launch business consists of about 20 operations a year. It is, in fact, the only economic spinoff of man's conquest of space, and generates an average turnover of well over 10 billion French francs [Fr] annually. The Europeans with Ariane—which just won a new contract in the United States yesterday to launch a "GE American" satellite in early 1996—and the Americans with their classic rockets restored since the explosion of the Challenger shuttle in 1986, now share the manna more or less equally.

#### Keeping Calm

The two suppliers are now looking at a competitor that could seriously shake them up. The Russians have hinted that a westernized Proton may sell for half the price of an Ariane. While the CIS is also marketing—at equally "bargain basement" prices—all of its space know-how, our report shows that no one is panicking in Europe. The Russians may have proven technical credibility, but they do not seem close to mastering the commercial capability that accounts for more than what it takes to win contracts.

Moreover, their space technology appears too different from the West's to enable it to be used as is, thereby stealing precious development contracts from Europe's industry. On the other hand, the example of the Hermes program demonstrates that the Russian threat is more real in the long term.

#### Views of Arianespace

93WS0309B Paris *LE FIGARO* (*LE FIG-ECO SUPPLEMENT*) in French 2 Mar 93 p 2

[Article by Jean-Paul Croize: "Arianespace Waits to Know More"; first paragraph is *LE FIGARO* (*LE FIG-ECO SUPPLEMENT*) introduction]

[Text] Arianespace, which holds nearly 60 percent of the world market, is counting on the "total package" concept to maintain its leadership.

"It is difficult to comment on such an agreement, because we don't know all the terms. Of course we are keeping an eye on it, but we are not panicking." Charles Bigot—the CEO of Arianespace, the company that markets the Ariane rocket—refuses to become overly alarmed about Russia's decision to share commercial marketing of the Proton rocket with the United States. It is still an extremely vague one, even if it has been

approved by the Russian government. Indeed, the agreement concerns only three of the launchers for now, whose selling price has not yet been set.

But if the Russians stick to the proposals they made in the second half of 1992, their launcher will apparently cost only half as much as Ariane. The international maritime telecommunications organization Inmarsat, which last fall purchased launches for a new series of satellites to be placed in orbit in 1995, paid \$36 million for a Proton rocket. In contrast, Arianespace charged Inmarsat over \$60 million for a berth aboard one of its launchers.

"The price of the rocket isn't everything. You have to look at all the services that are associated with an orbital placement, from operational availability on the dates the customer wants, to insurance and the guarantee of a quick relaunch in case of failure," explain Ariane officials. The company stresses that this "total package" concept has paid off handsomely over the last few years. With a total of 109 launch contracts to date, generating turnover of well over Fr40 billion, Ariane has captured nearly 60 percent of the international orders for orbital placement of civil satellites over the last 12 years.

Charles Bigot is counting on new productivity gains in all areas related to Ariane's operation to help Arianespace hold on over the next few years to what he estimates is half of the global launch market.

Mr. Bigot does not believe it will be too difficult to wait for Ariane V, a much heavier and more powerful launcher, to become available in 1996. By then Europe will have invested Fr34 million in Ariane V since 1987.

#### Code of Good Conduct

But the problem is that civil orbital launches—which have become an industry in every sense of the word, since the manufacture of Ariane keeps 12,000 people working in 60 European firms—may be in for a desert crossing over the next few years. Some forecasts predict only 15 annual launches between 1997 and 2002-2003.

If this happens, every defection of a potential customer to the Russians will hurt, especially in Europe where, unlike the United States, the space industry is not supported by military launch orders. Of the 100 satellites launched in the West, stresses Arianespace, fewer than 40 are open to European competition.

While Charles Bigot considers it natural that the Russians should jump into the game, he is asking that a "code of good conduct" be established to prevent them from practicing too much dumping. Engineers who have just visited Khrunichev plants say there are 20 or so launchers in stock, until Protons meeting Western cost criteria can be built. And if Russian statements are true, the "Soviet" cost of the rockets is no more than a million dollars—an amount that would seriously deflate prices if no rule is established.

**Effect on Hermes**

93WS0309C Paris *LE FIGARO (LE FIG-ECO SUPPLEMENT)* in French 2 Mar 93 p 2

[Article by Jean-Paul Croize: "The Eurorussian Hermes a Threat to 120 European Companies"; first paragraph is *LE FIGARO (LE FIG-ECO SUPPLEMENT)* introduction]

[Text] The decision to freeze the Hermes program until the CIS can participate has disgruntled the industry's manufacturers.

Europe's space industry is not overly afraid of Russian competition in the immediate future. But it does fear the loss of technology development contracts, which could be the serious flip side of joint programs, in the longer term. The "toughest" example of this is the Hermes shuttle. Hermes has been put on hold for three years following decisions made by Europe's space ministers in Granada last November, until preparations can be made to build it in full collaboration with the CIS.

The decision has been poorly received by the some 120 firms from 12 European countries which have lost a leading activity as a result. Hermes was to allow them not only to keep 2,000 highly skilled jobs, but to develop precious know-how in several cutting-edge technologies, such as new materials, aerodynamics, or hypersonic flight.

Their disagreement is so strong, in fact, that the temporary hold on Hermes is effective only at the government level. The manufacturing firms involved in the program are trying to continue work according to the original plan as much as possible, until there is a political about-face. This was shown in particular by the recently announced collaboration agreement between the European Propellant Company (SEP) and Aerospatiale, which together are pursuing the materials research necessary to manufacture structures and heat shields.

Development of the future spaceplane is being conducted within a European group called EuroHermespace that was created by Aerospatiale and Dassault for France, by the DASA group for Germany, and by Alenia for Italy. The bulk of the work on Hermes will be performed by our country, which is providing 43.5 percent of the funding.

**Delays and Inflation**

In keeping with the rules of the European Space Agency, the accord gives France the right to an equivalent "industrial return." The biggest share of the Fr52 billion "pie" is thus funneled back into our national industry, and involves 40 firms and a good thousand jobs, mainly in the Toulouse region.

It is thus understandable that the French favor continuing work on the Hermes. But Germany's and Italy's industries, which are providing 28 and 12 percent of the

program's budget respectively, also have high hopes of benefiting from a resumption of work within a purely European framework.

Adversaries of Eurorussian collaboration have a choice technical argument in Moscow's announced plan to develop a 32-metric-ton shuttle. A spaceplane of that tonnage will be much too heavy for the Ariane V rocket, which is supposed to be able to launch Hermes, whose maximal load is about 21 metric tons. "If we agree to get involved in the Russian project, we will lose all our independence by losing the capability to launch our spaceplane ourselves," say the manufacturers.

Decisions will probably hinge on how much the project will cost once restarted, notably after adjustment for inflation. "The longer a project is delayed, the more it costs in the end. Well, we have already lost six months since Grenada, without anything apparently having been accomplished. With or without the Russians, we will pay for that when it is finally decided to build the shuttle," contend industry people in Toulouse.

The hope is that development of the Hermes spaceplane will resume quickly, at least in France, after the legislative elections next March. Jacques Chirac has just spread assurances in the region that the RPR will disregard Europe's decision in Grenada last November to abandon Hermes. "The cost of Hermes is equivalent to 10 kilometers of urban highway, to be financed by 12 European countries over 8 to 10 years. Is that too much to bear for the independence and technological prestige it would bring to the whole continent?" ask the Gaullists.

**Reaction of SEP**

93WS0309D Paris *LE FIGARO (LE FIG-ECO SUPPLEMENT)* in French 2 Mar 93 p 2

[Article by Jean-Paul Croize: "SEP Looks at the Long Term"; first paragraph is *LE FIGARO (LE FIG-ECO SUPPLEMENT)* introduction]

[Text] The European Propellant Company is not worried by the Russians' plans.

"When you look at the different components of a Russian rocket, there is no reason for it to cost less than a Western launcher once it is produced in a real market economy." Jean Sollier, the CEO of the European Propellant Company (SEP)—which despite its name is a French firm with Aerospatiale and SNECMA as primary shareholders—does not think there is anything worrisome about competition from the East. Neither is he alarmed about the potential threat to our technology development programs that collaboration with Moscow might present. "Any plan to build a big system with Moscow is just a dream for now," he says bluntly.

SEP makes Ariane's rockets, and work to produce and develop new versions of them accounts for over 55 percent of the company's business. Strategic propulsion runs second, generating 19 percent. SEP has annual

turnover of about Fr1.8 billion, and is certainly the European firm that best knows Russia's space industry. As early as 1990, "We went there to look at everything we could find of technological interest," says Jean Sollier. The result was a total of 38 contracts signed with the various engineering and design departments and privatizing companies that SEP approached, worth a total of over Fr50 million.

### Developing European Cohesion

"If we had wanted to sign contracts like those now being established by some foreign firms, we would have done so long ago. But all our analyses show that we would not have gained from it. This is simply because their current systems are not adapted to international collaboration," continues SEP's CEO. In his view the problem runs deep and is a matter of "different technological cultures." The differences make Russian and Western rockets just as impossible to blend as the two area's railroads, whose tracks do not have the same gauge.

Instead SEP thinks the most valuable avenue to pursue with Russia is a sort of joint technology watch to prepare possible long-term developments, rather than trying to merge current propulsion systems.

Nothing very precise has yet been decided for the next 10 years. But prospects are considered particularly interesting in the area of new space propulsion systems and the use of new, apparently highly ingenious composites developed by the Russians and unknown in the West.

For the near future, rather than embarking on large-scale collaborative projects with Moscow, Jean Sollier thinks we must "continue to expand the notion of European cohesion." Ariane, which is a ESA program, leads a company like SEP to collaborate with 28 different firms in Europe. Since the program was formally launched in 1974, some habits have certainly been formed. But sharing budgets and know-how with EC neighbors still requires many quasi-diplomatic compromises.

### Ariane-5 Work in Progress Described

93WS0311B Paris AFP SCIENCES in French  
11 Feb 93 pp 7-10

[Unattributed article: "Ariane-5: Satisfactory Progress of Work at Kourou and Les Mureaux"]

[Text] Kourou/Les Mureaux—The first powder booster stage (EAP) of the future Ariane-5 European launcher reached its test bench in Kourou on 8 February; a test will soon take place.

Mounted vertically on a ferry, pulled on a double rail track by a specially designed truck, the booster stage—over 30 meter [m] high, 3 m wide, and loaded with 230 tons of propellants—covered uneventfully the 1,200 m from the integration building to the test bench.

Mr. Jean-Marc Artaud, head of the CNES [National Center for Space Studies] Ground Subdirectorate, indicated that it would be fired on Tuesday, 16 February, at or after 1300 (1600 universal time). However, significant uncertainties still remain as to the date and time of the experiment, as weather problems may arise.

Actually, Guiana is currently in the midst of its rainy season, so that it is impossible to guarantee ahead of time that the very strict environmental conditions (no rain, no contrary wind, no atmospheric turbulence, etc.) required to ensure the dispersal of the cloud produced during the two-minute propellant combustion will be met. The first day's window will close at 1630 (1930 universal time). The following day, firing might take place starting at 1100, local time. In spite of weather uncertainties, the people in charge of the experiment hope to complete it at the latest on Friday, 19 February.

Ariane-5 will be provided with two such booster stages (P230) attached along its central cryogenic stage (which uses liquid hydrogen and oxygen). Each of these side boosters will have a power comparable to that of the "strongest" configuration of the current Ariane-4: Ariane-44L equipped with four liquid-propellant booster rockets.

While retaining the family name, Ariane-5 will be quite different from previous launcher generations, in particular with respect to its propulsion method. This rocket, more than 50 m high, was adopted by the ESA [European Space Agency] in 1989 and developed by European manufacturers with the CNES as a prime contractor; it represents an investment of some ECU5 billion and is expected to provide net performance figures of 6,800 kg for a simple launch and 5,900 kg for a twin launch into geostationary transfer orbit, or to carry a 22-ton manned spacecraft into low orbit.

Over 90 percent of the takeoff power will be provided by the two booster stages, with a thrust of over 600 tons each; they will also remain preponderant during the first two minutes of flight. As for the main cryogenic stage (EPC) and its Vulcain motor (the seven Vulcain units manufactured so far have successfully undergone over 120 tests at Vernon and Leopoldshausen), they will provide power during most (10 minutes) of the future launcher's propelled flight phase.

To develop the P230, specific "tools" were required; in particular, an impressive powder-propellant test bench (BEAP) was designed and built at the Kourou Guiana Space Center.

This unique facility includes a tower that makes it possible to test-fire the booster actual flight configuration vertically, nozzle downward, astride a 60-m deep 200-m long flue designed to receive and channel flue gases and scatter them at high altitude.

The B1 test is the first of the eight or nine firings scheduled to test the behavior and performance characteristics of the load, the internal and nozzle heat shields,

first with axial thrust pickup, then, progressively, with dynamic nozzle deflections, the lateral thrust pickup and finally the qualification of a stage identical to the flight model. [punctuation as published]

The first propulsion unit is an experimental stage with a reinforced structure—in technical jargon, it is called a “battleship” (hence the B)—whose casing is 35-mm thick instead of 8 mm for flight structures.

Its operation will be monitored by 623 measurement channels which will transmit 400,000 points per second. Sixteen cameras, some of which “kamikaze” cameras destined to be sacrificed very quickly, will film the operation at close range.

Placed in a cage alongside the 50-m high concrete tower, the propulsion unit is surrounded by safety rings that do not touch it directly but would tighten around it should a problem arise. Therefore, it will normally complete a 5-cm “flight.”

Should it get out of control and take off, it would be pulled back to the ground by 300-m long fastening cables. The safety analysis also considered the possibility of an explosion of the propulsion unit whose full-scale operation, as Mr. Max Hauzeur, the ESA representative in Kourou, confessed, remains “a major unknown.”

Meanwhile, Aerospatiale, the industrial architect of the Ariane-family launchers, has started major overall tests of Ariane-5. At its Les Mureaux Space and Defense Division facilities, near Paris, static and dynamic testing of the very first main stage has begun; the tests include in particular a series of vibration tests simulating all flight phases. Electrical systems and the tracking and steering system are also being checked. Computer modelling is used to subject the launcher to the conditions it will encounter during launching (wind gusts, atmospheric pressure, etc.) and to generate “failures” in order to check all redundancy systems.

“This simulation effort is quite new compared with Ariane-4,” Mr. Serge Petit, director of the Ariane-5 program at Aerospatiale, pointed out, “and it enabled us to achieve a number of results already at the beginning of the year. In other words, Ariane-5 ‘flies’ already at Les Mureaux, albeit in separate pieces or during computer-simulated flights.”

For his part, Mr. Jacques Durand, director of the Ariane-5 program at the ESA, emphasized that “we still hope to complete the first launch in October 1995.” If all goes well, the first commercial launches might take place in April 1996, after a second qualification flight.

According to Mr. Durand, the fact that the Hermes project was thrown back into question at the recent European ministers’ conference in Granada (see AFP SCIENCES No. 847, 12 November 1992, p 5), does not in any way compromise the chances of success of Ariane-5, whose initial development was intimately linked to that of the spacecraft.

“As far as we are concerned,” he said, “the objective of 99-percent launcher reliability is totally independent of manned flights. It is a marketing argument that we shall retain anyhow, and which will come in addition to lower launching prices, 10 percent lower than launchings into orbit by Ariane-44L.”

### Luxembourg's SES Plans Fifth TV Satellite

93WS0311C Paris AFP SCIENCES in French  
11 Feb 93 p 10

[Unattributed article: “SES [European Satellite Company] Borrows to Finance Astra-1E”]

[Text] Paris—On 4 February, the European Satellite Company (SES) borrowed ECU220 million to finance its fifth satellite, Astra-1E, designed to “promote the introduction of digital television services in Europe.”

The Astra-1E launching is “scheduled for early 1995,” the SES indicated. The Luxembourg company “expects to be able to start digital broadcasting tests already in 1995”; the system “will improve the broadcasting cost-performance ratio, while offering European viewers a broader choice of programs.”

The loan to finance the satellite was signed with a 13-bank consortium, including BNP [National Paris Bank], Swiss Bank Union, Dresdner Bank, and Luxembourg companies, headed by the Luxembourg German Bank. In 1992, SES borrowed ECU135 million to finance the purchase of the Astra-1C and Astra-1D satellites, scheduled to be launched by Ariane rockets respectively next May and around mid-1994.

These satellites under development will be added to the existing Astra-1A and Astra-1B. Astra-1C will increase “the available repeater capacity” of the system from 32 to 48 channels; and Astra-1D will serve as a “backup” for the system as a whole, all of whose satellites will be at the same orbit location (19.20° East). The launching of a fifth satellite will give European viewers access to a still more varied series of channels and allow them to take advantage of the most recent technical progress in this field.

### French Space Budget, Priorities Presented

93WS0333 Paris LE FIGARO in French  
10 Mar 93 p 13

[Article by Jean-Paul Croize: “CNES [National Center for Space Studies] Budget Presentation; Space Sector: France’s Options”—first paragraph is LE FIGARO introduction]

[Text] Ariane-5 and its future spinoffs get the largest share; the shuttle project, the smallest.

“From now on, we must display our priorities more clearly,” Rene Pelat, the CNES president, just assured while making a detailed presentation of how the CNES intends to manage its 1993 budget—11.166 billion

French francs [Fr] or 4 percent more than the previous year. While the largest item remains space transport, under the "Science" title which gets a 27-percent raise, environmental studies experience a spectacular development, and their budget is doubled. Another priority displayed in the field of applications is "the study of future communication systems, which are one of the country's major stakes," Jean-Daniel Levi, the CNES general director, explained.

Although cut by 3 percent compared with the previous year, the title "Access to Space" will still remain the CNES's main expenditure item, accounting for Fr4.2 billion, i.e. approximately 50 percent of the French "program authorizations" in the space sector.

Not only will the CNES continue the development of Ariane-5, which is still scheduled to fly for the first time in the fall of 1995 and to be set into commercial service one year later, but the agency also decided to start financing studies of three variants derived from this future launcher, using the components and production facilities developed for the main version, Jean-Daniel Levi confirmed.

#### "Super-Launcher"

The first one will be an ultra-light launcher which for the time being is called "DLA P"; it would be used to launch into low orbit the small satellites of radio-broadcasting services. The second will be one "half Ariane-5" in terms of launching capacity; it would be designed mostly for observation and weather satellites. The last one will be a "super-launcher" for which Fr20 billion will be spent this year: called "Ariane-5 MK-2," it will possess improved performance characteristics compared with the basic model, thanks in particular to a 20-percent increase in the thrust of the Vulcain cryogenic motor developed by SEP [European Propulsion Company] for use on Ariane-5.

On the other hand, the title "Hermes" has disappeared from the CNES's "Access to Space" projects: all that is left is a "Spacecraft" heading whose budget—Fr556 million—was cut 40 percent compared with the Fr927 million devoted to that item last year. The remaining credits should make it possible to retain a small foothold by working along three lines until Europe decides, possibly in 1995, to develop a spacecraft: studies of areas of potential cooperation with Russia; definition of a possible rescue vehicle for the U.S. Freedom space station; and research with a view to the subsequent development of components required for autonomous manned flights, e.g. docking systems, remote manipulator arms, or spacesuits, to name just a few.

#### Priority to Telecommunications

Recently placed under the dual supervision of the Ministries of Research and Defense, the CNES now manages military space programs more directly. This activity should account for an additional income of Fr2.5 billion

per year over the next few years, but the CNES management decided that it would act only as a "service provider," based on priorities—and therefore, choices—that are still decided by the Ministry of Defense.

In the civil sector, the major national priority that the CNES should be promoting is expected to become the telecommunication sector, under the budget title "Applications" which was increased by 20 percent over last year, to Fr1.006 billion. Some of the leading objectives in this respect are the development of fiber optic links between satellites, which are currently being studied under Matra-Marconi's Silex project, and the definition of new mobile-tracking and radio-messaging concepts, or concepts of communications using minisatellites launched into low-orbit constellations.

#### CNES Building Martian Landscape

93WS0335C Paris *L'USINE NOUVELLE* in French  
25 Feb 93 p 40

[Text] The CNES (National Center for Space Studies) has just begun work on a 6,200-square-meter platform of "Martian" landscape at its Toulouse facility, at a cost of 6 million French francs [Fr]. The purpose is to reconstruct a life-size replica of the topography of the Martian landscape so that future planetary robots can be tested under optimal conditions. The pictures brought back by the American probe Viking will enable scientists to recreate a very faithful replica. Honeycombed boulders, 5-meter dropoffs, and 30-degree slopes are among the obstacles experimenters will use to test the robots' ability to move about.

#### Ariane 5 B1 Booster Test Successful

93WS0337B Paris *AFP SCIENCES* in French  
11 Mar 93 pp 14, 15

[Text] Kourou—Results of the first test of the future launcher Ariane 5's booster accelerator stage, which was checked out in a vertical position on the ground, 16 February, at the Guyana Space Center in Kourou, were positive. Jean-Marc Artaud, head of the CNES's sub-management division, and William Bonnet, who is in charge of environmental protection and safety at the GSC in Kourou, made the announcement on 5 March.

"All the observed parameters—the pressure and length of combustion, the temperatures of various booster components, the operation and control of the nozzle—performed satisfactorily and as predicted," commented Mr. Artaud. There are still over 570 measurements to be verified in detail.

"Starting with the next one," continued Mr. Artaud, "the seven tests remaining through 1995 will be run on flight structure, that is, [a structure] one-fourth as strong as the 16 February operation. They will enable us to integrate and test, little by little, all 'on-board' functions—in particular the installation of the on-board computer that operates the nozzle—right up to a near

autonomous booster. We will do them all on the ground, without launching the booster. The second trial is scheduled for mid-June, 1993, in Kourou."

As for the environment, Mr. Bonnet indicated that "weather conditions facilitated the best possible elevation of the cloud generated by the flue (...). There was no significant acid or aluminum fallout. One hundred metric tons of bottom granite that had eroded from the flue left with the cloud, and fell back to earth in a sand that contained minimal amounts of acid and aluminum."

"Rats placed at varying distances during the test were unaffected by the noise. When the animals were dissected in a laboratory a few days later, benign tracheal-pulmonary lesions that were starting to scar over were observed. So the results, though preliminary, are highly satisfactory. An upcoming plan of improved measurements will corroborate the February 1993 findings," concluded the GSC's environmental protection official.

### Ariane To Launch Arsene Minisatellite

93WS0337C Paris AFP SCIENCES in French  
11 Mar 93 p 15

[Text] Paris—The Arsene minisatellite that will help radio hams the world over communicate with one another will be placed into orbit in late April, together with Luxembourg's Astra-1C live-television satellite, on Ariane's next flight. Arsene will offer a special 20-hour radio link about every 60 hours.

Arsene is the first satellite in the world equipped entirely with gallium arsenide-cell solar panels, which dispense with the need for additional deployable panels. Arsene (Ariane Radio Ham Teaching Space Satellite) was produced at low cost but offers all the functions of a large satellite. It is the result of a collaborative effort kicked off 14 years ago by French and Italian space agencies and manufacturers, the Toulouse Advanced School of Aeronautics and Space (ENSAE), the Space Radio Ham Club (RACE), and other establishments.

The satellite is shaped like a hexagon, with a diameter of 79 cm and a height of 1.1 meters; it will weigh 153 kg at launch and 96 kg in orbit. Arsene is equipped with two repeaters that operate in the VHF (145 MHz), UHF (435 MHz), and SHF (2.4 GHz) frequency bands. The satellite will be controlled and positioned from the ground by a small STELA station that was designed by ENSAE students.

### Germany: MOMS-2 Long-Distance Camera Developed for D-2 Spacelab Mission

93WS0354A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 22 Feb 93 p 10

[Text] The ultra-high-power MOMS-02 optical remote sensing camera will soon be on board the German D-2 Spacelab mission. It is intended to record ground formations from a 300 km altitude with a detail resolution of

up to 5 meters. MOMS-02, the optical module for the modular optoelectronic multispectral stereo scanner for remote sensing from space, was developed, manufactured, and flight-qualified at DASA [Deutsche Aerospace AG]. It is a second-generation scanner. Besides four narrow-band spectral channels, it also has two oblique stereo channels and one high-resolution broadband channel. MOMS-02 reportedly offers for the first time the possibility of recording and combining the spectral properties of the earth's surface at the same time in three dimensions. Together with the simultaneous spectral and stereoscopic mapping of the earth's surface using digital photogrammetry, the concept of "three-line scanning" should also permit three-dimensional terrain reconstruction. By combining various filming modes, vegetation, rock structures, and soils can be used for mapping. For the first time, studies are possible on improving the spectral differentiation of various soils and geological surfaces and their exact spatial arrangement. Also for the first time, questions on detecting water catchment areas in regions with karst formations and an inadequate water network can be processed.

### Russian-German Space Program Develops Eye Pressure Meter

93WS0356A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 26 Feb 93 p 8

[Unattributed article: "Experiments by German-Russian Space Program Help Patients: Meter to Determine Eye Pressure; Study of Circulatory System and of Fluid Balance"]

[Text] Frankfurt—A little less than one year ago, German pilot Klaus-Dietrich Flade spent a week on board the Russian space station Mir where in earth orbit he conducted around a dozen biomedical experiments, which, according to information provided by the German space agency DASA [Deutsche Aerospace AG], have led to very interesting scientific results.

Thus, Prof. J. Draeger (University Clinic of Hamburg) reports on the development of a small hand-held device for measuring the internal eye pressure of astronauts, especially at the beginning of flight.

Under zero gravity, bodily fluids rise to the upper half of the body, so that dangerously high tonometric values are possible in a space traveler. It is only over the course of the mission that eye pressure again drops. The new meter will soon be available for sale to anyone at a relatively low price, if there is a danger of the "green star" due to excessive internal eye pressure and the threat of blindness.

In another experiment during the Mir flight, Flade studied the balance organ in the inner ear together with its ability to process reference values by way of the eye, even under zero gravity. Such detailed studies are not

possible on earth, because the normal force of attraction covers up all the finer characteristics of the vestibular organ.

"With minor modifications, even the experimental instruments specially developed for such studies in earth orbit can be used in clinical practice in order to better study, and subsequently treat, disruptions in balance, especially among the elderly," says Prof. K. Kirsch (Free University of Berlin), explaining the background of the space experiment.

There are similar practical uses of certain other devices developed for the Mir experiments. In all cases, it involved determining the physical and mental sensitivities and reactions of the astronaut to the zero gravity present in space, and his special situation in the space station in special areas of medicine.

However, the medical findings from this space flight are not an end in themselves, because the results in the areas of the circulatory system and the fluid balance in the human body are necessary and important to a better understanding of organ functions in space. For example, new treatment methods can be developed for patients who are suffering from edemas or who must spend many months in bed.

On the whole, few experiments were possible on the Mir mission due to technical and weight considerations, which has been frequently regretted. It is possible that a German astronaut will go along again in 1995, in which case he would spend as much as one month on the Mir station. However, the approximately 50 million German marks [DM] needed for that have yet to be approved.

#### Bremen Company Builds Minisatellites

93WS0359C Hamburg DIE ZEIT in German  
19 Mar 93 p 61

[Article by Anatol Johansen: "Small and Cheap: Minisatellites Could Be Developed Into the PC's of Space; Vigilant Dwarfs in Space"]

[Text] But it will not be flying at this time: Brem-Sat, a minisatellite built by Bremen engineers, which was originally supposed to have been launched with the D-2 mission and later automatically perform experiments in space. Since there are still problems with the launch mechanism on board the space shuttle, Columbia, the premiere performance of the compact "technical whopper" (see ZEIT, No. 53, 1992) has been canceled for the moment. However, the time has come for custom-made microsatellites. As "PCs of space," particularly in the future they are expected to increasingly more often compete with conventional space projects.

Normal satellites today reach the size of a bus and quickly cost more than \$1 billion. It doesn't have to be that way, in the opinion of Manfred Fuchs, a medium-level industrialist from Bremen who specializes in gaps in the space market. He built the SAFIR (satellite for

information relay) minisatellite for only DM6 million. It is designed to protect against auto theft, for example: A transmitter, the "SAFIR microstation," is built into the frame of the vehicle—and indeed in such a way that removal of the cosmic "bug" would considerably reduce the value of the car. If the new limousine should be stolen, its location can be determined via satellite within hours.

With the aid of his SAFIR minisatellite, Fuchs can offer even more services; for example, scientific measurement stations that are at sea, in rugged country, or in the Antarctic can be called on to report. Likewise, SAFIR is designed to pick up emergency messages from mountain climbers or sailors involved in accidents. The alarm transmitter needed for this weighs barely 100 grams so that it does not further interfere with the compact, lightweight nature of the mountain climber's pack. SAFIR could also track trucks and freight cars.

All this can be arranged at acceptable prices. So a minitransmitter for the lone adventurous tourist, for example, costs about DM2,500 and a single position fix DM30. To be able to keep prices low, Fuchs wants to launch his satellite with the comparatively cheap Russian booster rockets—for only about DM150,000.

The first SAFIR will probably be launched as early as this coming June as extra payload with the launch of the Russian earth reconnaissance satellite Resource-01 N3 on a Zenith rocket. The second SAFIR would then follow it next year.

The Bremen industrialist is so convinced of [the success of] his idea that he is by no means thinking of selling his satellite. He wants to operate his SAFIR network himself. The interest recently displayed in him and his satellite system at the Online '93 telecommunications exposition in Hamburg has only confirmed him in this attitude.

Manfred Fuchs is not alone in his ideas. Universities have been working on their own cheap minisatellites.

In addition to the builders of Brem-Sat, there are the students of the Berlin Technical University (TUB) with "TUBsat" or their fellow English and American students with their own "Smallsats" (Small Satellites). And short-wave amateurs have been sending their little "Amsats" up for many years now along for the ride with launches of big satellites at no cost or at minimal prices.

Meanwhile, small and comparatively cheap satellites are also penetrating business sectors which up to now appeared to be holding large costly devices in geostationary orbit in reserve at an altitude of 36,000 km. Thus the American firm Motorola, Inc., in Illinois wants to launch its "iridium system" with 77 satellites and hopes to be able to build up with it a worldwide operational radiophone system by 1996. On the other hand, 20 satellites are supposed to belong to the internal American "Orbcom system," which is scheduled for 1994.

At the same time new launch possibilities for the small satellites are also turning up at reduced prices. Thus Brazil, for example, launched its first SCIDI satellite on 9 February on a Pegasus rocket, which was developed without public funds by the private American Orbital Science Corporation for launching smaller satellites. The solid-fuel-propelled rocket was towed to an altitude of about 12 km by an American B-52 bomber and released there after the aircraft had attained 80 percent of the speed of sound. Only then were the Pegasus engines ignited and they brought Brazil's first satellite into its orbit.

In an opinion recently expressed by German astronaut Ulf Merbold, space travel is going through a "slack period" worldwide. But while the fans of weightlessness dream of a "return to the moon," the "advance on Mars," or other big new projects, perhaps the space renaissance will unfold in a much less spectacular way. The modest little custom-made satellites could, in conjunction with cheap launch rockets, possibly lead to an undreamed-of popularization of space. When will you have your minisatellite?

#### DASA's Plans for Regional Airliner, Cooperations Criticized

93WS0362A Duesseldorf HANDELSBLATT in German  
23 Mar 93 p 3

[Article by Michael Hill: "Deutsche Aerospace: Management in Regional Airliner Frenzy: Solo Course Despite Three Competitive Projects"]

[Text] There have been critical national concentration processes underway in Europe's aviation industry over the past two decades. In contrast, no progress has been made in this regard on the international scene. Although Airbus Industrie trades under the name of a controlling company, it is actually only a multinational marketing, sales, and settlement company. Other cooperation within Europe is largely restricted to project-related cooperations or specialized subsidiaries of two or three national firms. People in Great Britain, France, and even Germany shy away from cost-saving, genuine Europeanization, which also transforms these national "interim creations" into larger entities.

What is happening now in Europe—and regrettably, not least of all because of the stated intention of Daimler-Benz subsidiary DASA [Deutsche Aerospace AG] to speak with its own voice in as many areas of aviation as possible—appears to be counteracting the goal of a European aviation industry as a real counterpart to the big U.S. companies.

Thus, DASA is considering reviving the "Regioline"—the improvement on the "MPC" previously planned with China—under the new name "Future Advanced Small Airliner (FASA)." Comparable plans are also being made at Fokker, in which DASA is currently

participating. Moreover, the market for regional jets can scarcely be kept track of any longer, due to the competition's existing products and projects on the drawing boards. Thus, any additional product entails extraordinarily high risks. However, this seems to be of little concern to DASA management. Thus, the FASA project is justified by the assertion that ultimately the customer should be able to decide what he will buy in the 120- to 130-seat jet class: a largely purebred DASA (FASA) project; a lengthened F 100 as a Fokker/DASA product, or an Airbus A 319, with final assembly by DASA in Hamburg. And in the end, all of this is financed from the same pot.

And if one notes further that the French (Aerospatiale) and the Italians (Alenia) would be "welcome to come to us" if they want to further develop their ATR family—which is already successful on the market—for the same market niche, then this sounds more like "high-horse talk" than well-conceived strategy.

This is explainable only if the same thing is true of the lower class of the medium-range jets that has repeatedly been heard as a justification by DASA for the concentration of A 321 end production in Hamburg, for which the company has paid dearly: "We want to finally have a passenger airliner made in Germany again."

Something else that fits into the picture of assuming a more national profile rather than cooperating more closely on the European level—the goal of which is to minimize cost and effort—is the media-effective DASA move made a little while ago to study with Boeing the project for a new supersize passenger airliner. Although a linguistic adjustment was made after a few days in order to eliminate the friction among other Airbus partners over this German solo course, retribution was forthcoming from France: the announcement of a close tie between Aerospatiale and the Russian aviation industry.

The mixture of DASA solo courses, which have caused a lot of unnecessary trouble, and expensive pipe dreams is hardly suitable for making a positive contribution to the Daimler-Benz balance sheet in the medium term. Perhaps the courage to assume incalculable risk is the result of the—given the drastic cuts in military orders—only temporary black figures at DASA. If reference is made in this regard to the positive results of the Airbus commitment, it remains unspoken that these earnings are due only to prior Stuttgart-Bonn agreements. Because they allow rather generous financing of Airbus development and sales with German taxpayer money, despite the assumed repayment obligation. But even this does not justify now entering into risky high-prestige adventures in a market where there are already enough products and projects, but few buyers.

**German-Built Environmental Observation Satellite  
"Temisat" Described**

*93WS0365C Duesseldorf VDI NACHRICHTEN  
in German 12 Mar 93 p 27*

[Article: "Space Lookouts Monitor Environmental Events"]

[Text] VDI-N, Munich, 12 March 1993, E.S.—Telespazio, with headquarters in Rome, is the customer's name. A rocket enterprise in Moscow is handling the powerful thrust heavenward. The Munich firm of Kayser-Threde is building the "Temisat" compact environmental observation satellite that is supposed to be sent up along with a Russian weather observation satellite named Meteor-2.

The tiny "Temisat" satellite is "in contrast to experimental precursors, the very first commercial and professional microsatellite system for the recording and transmission of environmental data, declares Niko Balteas, Ph.D. (Engineering), program manager for satellite, communication and navigation systems at the Munich space specialists Kayser-Threde with its rich traditions. This coming July it is supposed to soar heavenward from the Russian launchsite at Plesetsk piggybacking on the Meteor-2 and then, using a Cyclone rocket, "be placed into a low polar orbit, that is, crossing over both poles," and then in September begin its task. That is, incidentally, the time when Kayser-Threde already plans to see off a second microsatellite—in fact, a Berlin Technological Institute [TU] "Tubsat" research satellite—along with a Meteor-3. It is said that the Munich firm in this case, incidentally, is supposed to assume "responsibility for the Tubsat payload and launch" as well as its additional loadings.

The cube-shaped Temisat, weighing only 30 kg and with a length of 350 mm along its edges, will collect and forward environmental data originating from single and autonomous measuring stations. In doing so, for the first time now an automatically operating data network based on an inexpensive satellite system is supposed to function with the use of a very powerful technology that specialists know as time division multiplex access [TDMA]/SCPC and thereby "one of today's most innovative and effective communication technologies is being put in the service of environmental protection," as Balteas proudly emphasizes.

Balteas declares, "modern technology's highly developed, high-speed electronic components currently permit very rapid and flexible development of individual communication networks and radio links." Above all, the system functions with very high throughput and a high degree of data security through the use of regeneratively operating channels that boost the data both in orbit as well as on the ground.

In the extremely hurried development of the microsatellite, for which only one year was allowed, from the signing of the contract to launching, "we have come up

with a wholly redundant design and as far as possible we have used components that are proven and space-certified," says Balteas. The work has been done by a small project team virtually without subcontractors, "as much as possible resorting to off-the-shelf standard parts and software modules. Moreover, we have avoided as much as possible developing anything from scratch."

Specifically, the operation of the total data communication system is supposed to proceed so that, whenever the satellite is just "visible," the system control center [OCC] sends it special remote control [TC] and polling data signals via its remote control channel. Once the satellite has received those it forwards them to the various data collection centers [DCC] and user terminals [UT] on the ground, while itself otherwise commences beaming data containing information on its present orbital position and other systems data.

During each overflight every 104 minutes, the satellite, circling at an altitude of 950,000 m, simultaneously assembles the data from a maximum of eight data collection and user stations previously flagged for it by the system control center. It processes and multiplexes them and then immediately retransmits them down to earth while simultaneously storing them in mass storage for later polling. This enables all system control centers and data collection stations equally within each "field of vision" to receive the data beamed down by the satellite. Balteas states, "this ensures a continuous flow of data between the satellite and the ground units."

In a total system context, the system control center controls the operations of the satellite itself as well as access to its channels. Each of the data collection stations is responsible for a specified group of user stations that they too in turn can remotely control via the satellite.

Balteas's company competed the Temisat for the Telespazio contract even "driving off the field a strong competitor, the U.S. Interferometrics company," as Balteas proudly points out. The Temisat is passively stabilized via a magnetic field. On standby it consumes two watts and at its maximum, 60 watts of energy and offers a maximum of 64 analog and digital channels just for registering and monitoring its own internal system status.

In addition, 10 receive-channels and three transmit-channels are available for actual effective operation with three more—initially inactive—reserve send-channels standing by. Depending on the operational status and the type of data, the latter are transmitted at 1200 to 4800 bauds. Hence as a result of multiplexing, the data transmit-rate is four times as great as the receive rate.

A multiprocessor system based on four transputer chips handles internal control of the satellite, which is designed with full redundancy and also possesses a host of additional single-chip microcomputers. The result is a second unused system ready on standby to jump in any time there is a failure and thereby safeguard the investment in the satellite.

The total order for the Temisat system is valued at approximately \$10 million for the two satellites, the one system control center, the 50 data collection stations and the 1000 user stations that are presently supposed to be manufactured and delivered by Kayser-Threde.

### Germany: Eurofighter Program Faces Financial Problems

93MI0391 Munich SUEDDEUTSCHE ZEITUNG  
in German 24 Feb 93 p 2

[Text] Following cuts in the budget for the controversial successor to the F-90, the *Eurofighter-2000*, the Defense Ministry faces new problems. Government sources in Bonn stated on Tuesday that the 1993 defense budget has to cover "carry-overs" from last year totaling 180 million German marks [DM] and consisting mainly of administrative costs for the arms programs. The industry normally records such items at the end of the year, with the result that they affect the following year's budget.

The original budgetary appropriation for the *Eurofighter* had already been reduced from DM830 million to DM520 million, and industry and ministry experts had reportedly conducted intensive discussions on how the reduced funds should be allocated. The ministry intended to reach agreement with the German industry and with its partners, Britain, Italy, and Spain, on restructuring the project by the middle of 1993.

The business magazine CAPITAL has reported that the 1993 defense budget was short of DM680 million needed for financing the fighter. The magazine referred to a confidential "Interim Report on the Eurofighter Program," according to which the delay caused by Ruehe over the fighter project "has upset the entire budget."

The prototype *Eurofighter* is likely to make its maiden flight this year in Germany. British Defense Procurement Minister Jonathan Aitken has stated in a reply to a parliamentary question that the maiden flight of the German built prototype had been delayed by the revision of the DM53-million project; in addition, there were still problems with the computerized flight control system.

### Germany: Computer-Simulated Space Transportation System Described

93MI0401 DLR NACHRICHTEN in German  
Feb 93 pp 14-18

[Article by Dr. Dieter M. Wolf, Space Systems Analysis Division of DLR, Cologne-Porz: "TRANSYS—A Program System for Space Transportation Systems Planning, Analysis and Appraisal: Development of a Computer-Simulated Appraisal and Optimization Technology"]

[Text] The multidisciplinary program system TRANSYS (Transportation System) makes it possible to perform design and planning studies, parameter studies and comparative appraisals for a wide range of future space

transportation systems. This article describes the current state of development of TRANSYS and discusses extensions, both in progress and planned.

Towards the end of the decade, decisions are expected worldwide on a new generation of space transportation systems that will replace systems such as Ariane-5, the American space shuttle, etc., around the year 2010. At the same time, new mission objectives such as the space station and Space Exploration Initiative (SEI) will require novel transportation systems like heavy-duty transporters, orbital transfer vehicles, and planetary transport vehicles.

The increasing variety and complexity that this will entail for future space transportation systems make it essential for the DLR [German Aerospace Research Institute] to have corresponding space transportation systems appraisal and optimization capabilities to enable it to make technical analyses and comparative appraisals of various space transportation concepts, submit its own proposals for new space transportation strategies, and assess the relevance of technological developments for system development.

The basis for this is a computer-aided system designed to ensure the smooth interaction of specialized methods and simulation models with system appraisal procedures, multiple-objective parameter optimization, and database-supported software for recording the appraisal and optimization results in a retrievable form.

To meet these requirements, the TRANSYS program system is being developed by the Space Transportation Systems Analysis Division in collaboration with a number of DLR institutes and various universities.

TRANSYS is a high-level interdisciplinary program system that, apart from such engineering specialties as aerodynamics, aerothermodynamics, motive power engineering, trajectory mechanics, structural mechanics, thermal analysis, vehicle guidance and control, etc., also embraces aspects of space transportation system operation and their environment-compatibility (figure 1).

### Primary Applications

TRANSYS's primary applications are in earth-orbit carrier vehicles, orbital transfer vehicles with or without aerobraking/aeromaneuvering facilities, and planetary transportation vehicles. Initially, priority will be given to investigating derivatives and successor systems to Ariane 5 and Hermes, including both evolutionary and novel systems like the single-stage Delta clipper concept. In addition, studies of orbital transfer vehicles will shortly be commenced, looking at both conventionally powered systems and transfer vehicles with advanced or unconventional forms of propulsion (e.g., nuclear-thermal propulsion). Later, planetary transportation vehicles will also be studied. These studies are of special interest for developing mission and usage strategies for future moon and Mars programs.

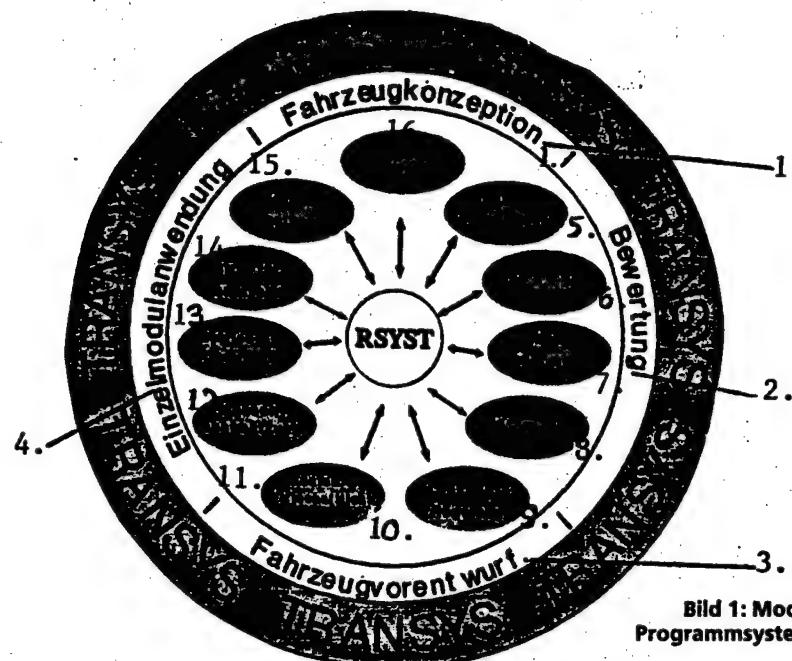


Bild 1: Module des  
Programmsystems TRANSYS.

TRANSYS Program System Module

Key: 1. Vehicle conception 2. Appraisal 3. Preliminary vehicle design 4. Individual module application 5. Aerodynamics, aerothermodynamics 6. Propulsion 7. Trajectory analysis 8. Geometry 9. Guidance and control 10. Costs and economic efficiency 11. Mass estimation 12. Operation and infrastructure 13. Structural analysis 14. Thermal analysis 15. Environment-compatibility 16. RSYST

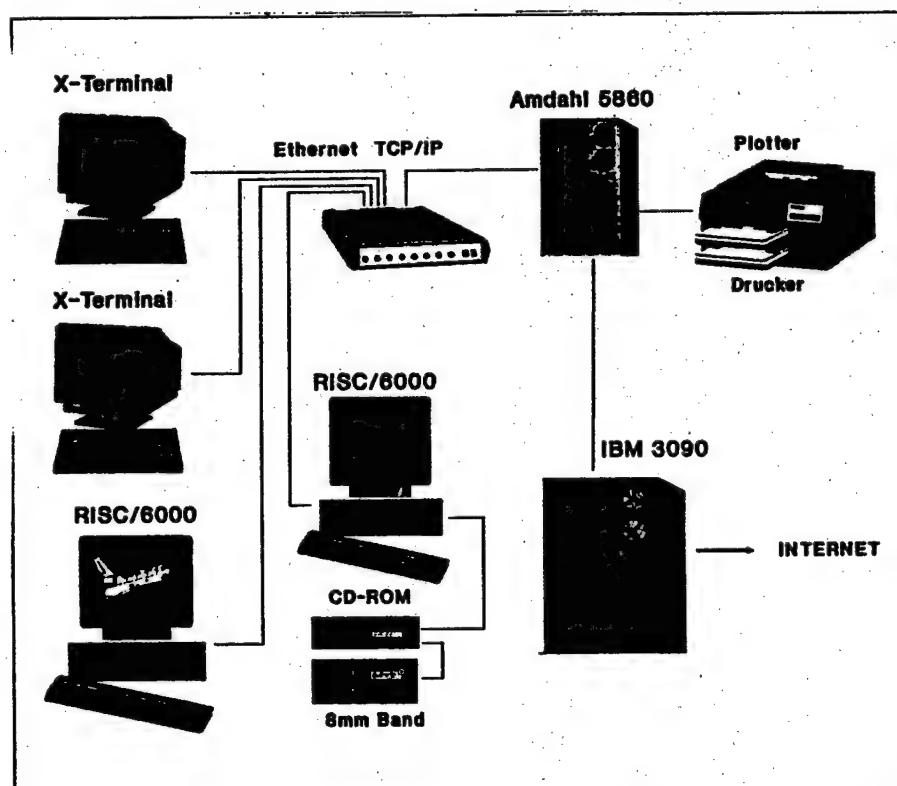


Bild 2: TRANSYS Rechner-Konfiguration.  
TRANSYS computer configuration

### Structure

The TRANSYS program system is of modular structure, each module consisting of various application programs and databases. Data management is handled by the RSYST data and methods base system, in other words there are no interfaces between the modules (see figure 1). RSYST is also used to control automated calculation loops. TRANSYS is operated interactively, the user interface is menu-controlled and OSF [Open Software Foundation] motif-based.

The TRANSYS program system is installed on RISC [reduced instruction set computer]/6000 workstations and runs under the AIX operating system. The workstations and several X stations are networked with each other and with the mainframe computers in the Cologne-Porz and Oberpfaffenhofen headquarters (figure 2).

### TRANSYS Version 1.1 Capability

The currently available TRANSYS version 1.1 (April 1992) can plan, analyze and appraise earth orbit carrier and orbital transfer vehicles (OTV) at the preliminary design stage. But, generally speaking, this version can only handle vehicles with a rocket main drive.

Carrier vehicles must have no more than three stages, and they may also use two different booster types (like Ariane-44LP). They may have tandem or parallel stages, and provision may also be made for fuel transfer in the latter case. Apart from vertical and horizontal launch, aircraft-assisted take-off is also possible. The admissible stage types are nonrecoverable ballistic systems [ballistische Verlustsysteme] and winged systems.

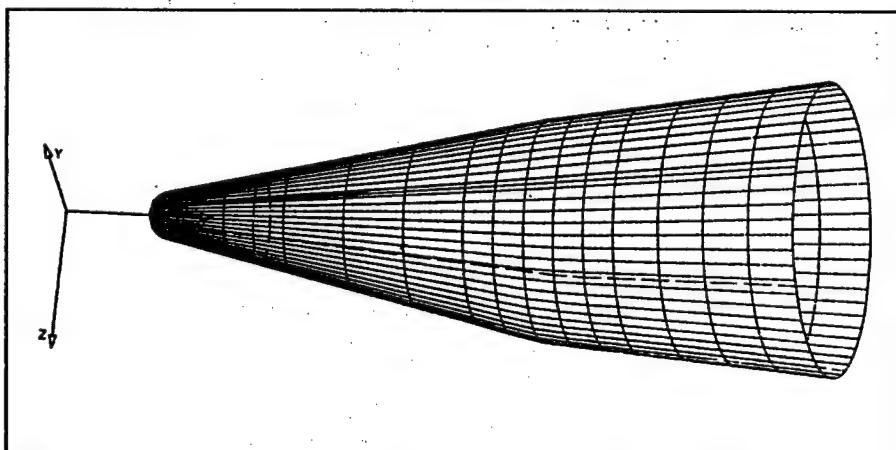
The conventional OTVs admissible in TRANSYS 1.1 must have no more than two stages. For aircraft-assisted OTVs, conical, slender, and double conical systems can be handled (figure 3).

The aerodynamics, propulsion, trajectory analysis, geometry, costs and economic efficiency, and mass estimation modules are used for analyses and appraisals. The performance scope of these modules is shown in Table 1.

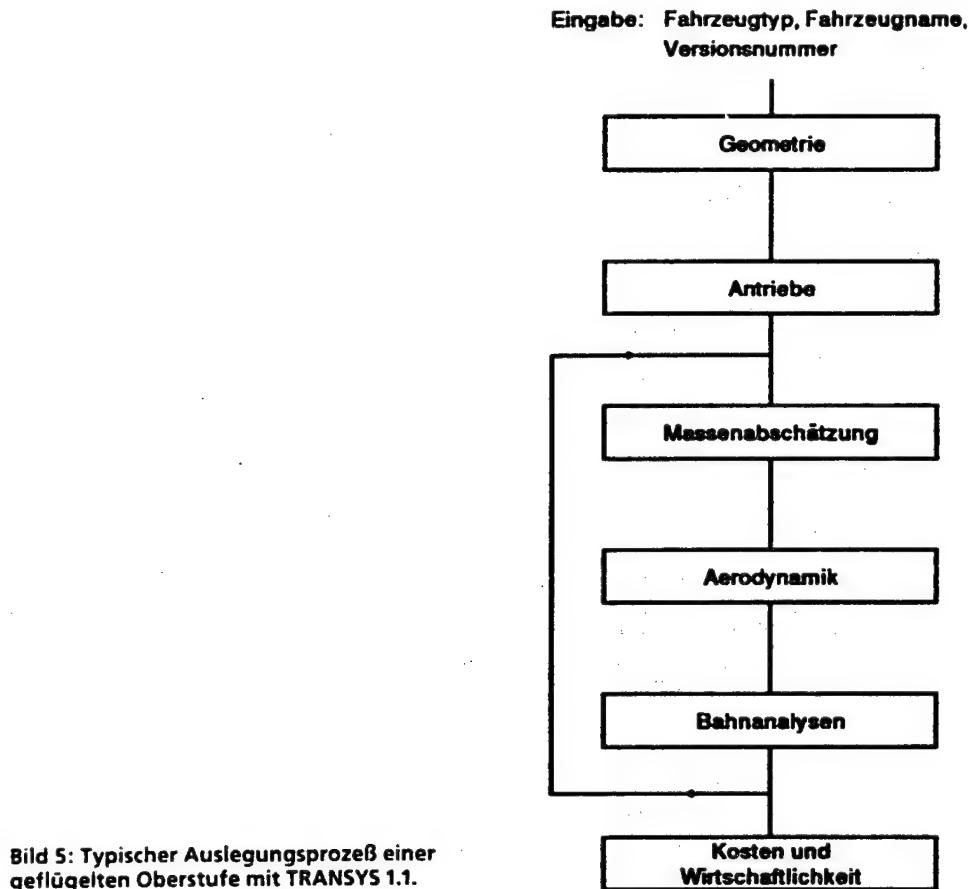
### Performance scope of the modules in TRANSYS 1.1

Aerodynamics module	Generation of surface meshes for aerodynamic and aero-thermodynamic studies and display using the CATIA CAD [computer-aided design] system (see fig. 3)
	Estimate of the aerodynamic coefficients of individual stages and of whole configurations
	Subsonic and hypersonic trimming of winged systems
	Aerofoil design
Propulsion module	Power and mass calculation for a wide variety of liquid-propellant rocket engines
	Databases for attitude control and orbital maneuver jets
Trajectory analysis module	Simulation and optimization of
	—ascent, return, and reentry trajectories
	—transfer trajectories with and without earth atmosphere immersion maneuvers
Geometry module	Configuration selection and calculation of vehicle's external contours
	Display of calculated external vehicle contour with CATIA CAD system
Costs and economic efficiency	Forecasts of development, production, and whole life cycle costs for given mission scenarios based on the TRANSCOST costing model
Mass estimation module	Calculation of mass of vehicle components and total vehicle mass
	Calculation of vehicle size including aerofoil design for winged systems (mass minimization)
	Representation of the calculated vehicles with the CATIA CAD system

Bild 3: Oberflächennetz eines doppelt-konischen AOTVs.



Surface mesh of a double conical AOTV [aircraft-assisted orbital transfer vehicle]



Typical process for designing a winged upper stage with TRANSYS 1.1

Key: 1. Input: vehicle type, vehicle name, version number 2. Geometry 3. Propulsion 4. Mass estimate 5. Aerodynamics 6. Trajectory analysis 7. Costs and economic efficiency

In addition, the structural mechanics module contains programs to determine the mass of tanks, delta wings, and landing gear by load analysis. The thermal analysis module contains a TPS database and a program for calculating two-dimensional unstable temperature distributions.

#### Vehicle Design With TRANSYS 1.1

The basic procedure for designing space transportation systems using TRANSYS 1.1 is illustrated in Figure 5, taking a winged upper stage as an example. As this diagram shows, the various modules are used sequentially in the iterative design and optimization process.

Once the vehicle type, vehicle name, and version number have been entered, the geometry module selects the vehicle configuration type and calculates the external contour according to the input parameters. The vehicle can then be displayed using the CATIA CAD system (figure 4).

The propulsion module determines the rocket engine types for the main drive, the orbit maneuver system, and the attitude control system, and calculates the corresponding power data or supplies them from a database.

The mass estimate module then calculates the various component masses and the total vehicle mass on the basis of a fuel mass that is first estimated and then calculated. The wing mass can be minimized in the light of hypersonic stability criteria. The fixed handicap for mass analyses is the launch mass, and the result of prime interest is the vehicle payload capacity.

The aerodynamics module calculates or supplies from a database the lift and resistance coefficients needed for the trajectory calculations. The results from the trajectory analysis module—mainly fuel masses and maximum loads flown—start the iteration process again with the mass analysis.

The iteration process ends either when the difference between some significant parameters falls below preset limits or when a given maximum number of iteration steps is reached.

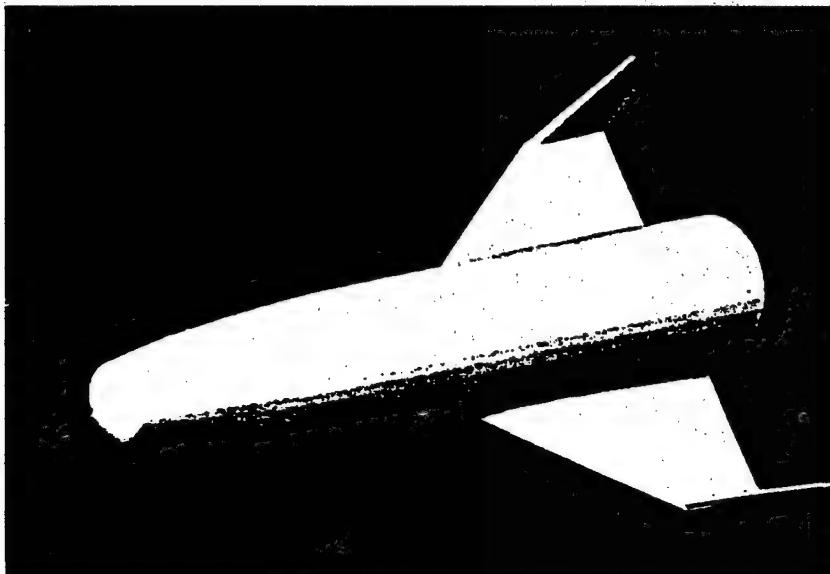


Bild 4: CATIA-Darstellung der äußeren Kontur einer geflügelten Oberstufe.

CATIA display of the external contour of a winged upper stage

When the vehicle design process is complete, the costs and economic efficiency module can be used to estimate the vehicle development, production, and operating costs on the basis of a predetermined transportation scenario.

### TRANSYS 2.0

TRANSYS 2.0 was defined as the objective for the further development of TRANSYS. It comprises the following modules (Figure 1):

Aerodynamics and aerothermodynamics, propulsion, trajectory analysis, geometry, guidance and control, costs and economic efficiency, mass estimation, operation and infrastructure, structural analysis, thermal analysis, and environment-compatibility.

Unlike the present version, TRANSYS 2.0 will offer the user the choice between the following four applications:

- Individual module application;
- Vehicle conception
- Preliminary vehicle design
- Appraisal

Table 2 illustrates how the modules are assigned to the various applications, taking the earth orbiter carrier vehicle (EOV) as an example. The vehicle conception section is much the same as in TRANSYS version 1.1.

TRANSYS 2.0 (earth orbiter vehicle)			
Individual module application	Vehicle conception	Preliminary vehicle design	Appraisal
Aerodynamics and aerothermodynamics	Aerodynamics and aerothermodynamics	Aerodynamics and aerothermodynamics	Costs and economic efficiency
Propulsion	Propulsion	Propulsion	Operation and infrastructure
Trajectory analysis	Trajectory analysis (3DoF)	Trajectory analysis	Environment-compatibility
Geometry	Geometry	Geometry	
Guidance and control	Mass estimation	Guidance and control	
Costs and economic efficiency		Mass estimation	
Mass estimation		Operation and infrastructure	
Operation and infrastructure		Structural analysis	
Structural analysis		Thermal analysis	
Thermal analysis			
Environment-compatibility			
Applications of TRANSYS version 2.0			

TRANSYS is steadily being expanded in scope so that version 2.0 at the latest will also be able to handle carrier vehicles with air-breathing boosters, CCUs (control configured vehicles), reusable ballistic vehicles, and orbital

transfer vehicles with nonconventional propulsion (e.g., electric propulsion, nuclear-thermal propulsion), and planetary transporter vehicles.

In addition, environmental impact, particularly for earth-launched carrier vehicles, will in future be included as an appraisal and optimization criterion. The environmental impact module will be able to consider not only engine exhaust fumes emitted on ascent and return, but also the effects caused by friction, surface interaction, and shock waves on reentry into the earth's atmosphere.

Moreover, the design of future space transportation systems will increasingly have to take account of operational aspects. This requires that the requisite tools be brought in at a very early stage in the vehicle design process so that due account may be taken of operational, and therefore also cost, aspects.

Significant progress in further developing TRANSYS will also depend on whether it proves possible to incorporate a CAD system into TRANSYS. The CAD/CAE [computer-aided engineering] system would have to be a "subroutine" taking over major functions of the geometry module and also be usable in the aerodynamics and aerothermodynamics, mass estimation, structural analysis, and thermal analysis modules.

Details of the extensions in hand or planned to create TRANSYS 2.0 are shown in Table 3.

Expansions in hand and planned for TRANSYS 2.0	
Aerodynamics and aerothermodynamics	Integration of Euler code calculations
	Performance of stability analyses
	Development/integration of a program for initial estimates of temperature distributions on the vehicle surface
Propulsion	Implementation of new rocket engine cycles
	Generation of an air-breathing booster database
	Database creation or software development for calculating the power of nonconventional boosters
Trajectory analysis	Development of an enhanced 3DOF and a 6DOF simulation program
	Development of programs for calculating Earth-Moon-Mars transfer trajectories
Geometry module	Integration of a CAD/CAE system
	Increase number of configurations for existing vehicle types (external contour and internal layout, e.g., location of tanks)
	Implementation of new vehicle types, e.g., winged systems with canards, reusable ballistic systems, transfer vehicles with nonconventional boosters
Mass estimation module	Introduction of additional mass components required

	Improvement of mass models, taking account of different materials and construction methods
Structural analysis module	Development of R&D models for designing and calculating the mass of main components
	Development of programs for analytical mass calculation of subcomponents
	Generation of mass models for structural components by parameter variation and integration in the mass estimation module
Guidance and control	Implementation of guidance laws for ascent, return, reentry, and trajectories with immersion maneuvers
	Integration of control concepts/laws for ballistic and winged systems and for AOTVs
Operation and infrastructure module	Integration of databases with terrestrial and orbital infrastructure
	Development of empirical models for the rough design of infrastructure systems
	Development of methods or models for appraising the operational expenditure for space transportation systems
Costs and economic efficiency module	Improvement and expansion of existing cost estimation methods for operating costs
Environment-compatibility module	Development of criteria and models for assessing the environment-compatibility of space transportation systems

### Germany: R&D at DLR Microgravity User Support Center Described

93MI0403 Cologne DLR NACHRICHTEN in German  
Feb 93 pp 19-24

[Article by Dr. Klaus Wittmann, DLR Space Simulation Institute, Cologne-Porz and Engineer Dittmar Padeken, DLR Flight Medicine Institute, Cologne-Porz: "MUSC Microgravity User Support Center: Space Experiment Support"—first paragraph is DLR NACHRICHTEN introduction]

[Text] The DLR [German Aerospace Research Institute] Microgravity User Support Center in Cologne-Porz assists scientists from all ESA [European Space Agency] member states, the United States, and Japan in the preparation, performance, and evaluation of space experiments. Ideas are thus converted into flight-ready space experiments.

Earth-orbiting laboratories are widely used for experiments under space conditions. In the material and life sciences, the focus is on the use of microgravity, which is virtual weightlessness. Gravity has a marked effect on a number of physical processes. It is particularly noticeable in systems containing fluid components, as in a melt for growing crystals, or in a biological organism. Convection, floating, sinking, and hydrostatic pressure are important phenomena here. The absence of the earth's gravity means that novel processes can be used, such as the largely force-free positioning of samples by the floating zone method. Material and life sciences research

under microgravity has given the DLR a wealth of experience with manned and unmanned space laboratories. The DLR makes this experience and its specialist knowledge of space experimentation techniques available to interested scientists and industrialists in the Microgravity User Support Center (MUSC), where the emphasis is on helping to translate ideas into flight-ready space experiments. The MUSC is run by the DLR Space Simulation, Flight Medicine, and Materials Research Institutes.

The aim of the User Support Center is:

- to facilitate access to space experiments and attract new users;
- to contribute to the scientific success of experiments by providing technical and scientific support during their preparation, performance, and evaluation;
- to cut costs by using pooled experience.

The User Center mainly runs multi-purpose systems that are used by several experimenters working on a variety of scientific problems. It provides back-up for space experiments in the material sciences, physical chemistry, biology, and human physiology under microgravity. It also supports experiments in planetary and cometary physics, radiation and exobiology, and ecology.

The DLR has been providing user support programs since the first Spacelab mission in 1983. Preparations for experiments in the materials laboratory, which was carried for the first time on this mission, began in 1979. Since then, the MUSC has supported about 180 experiments for Spacelab, TEXUS, and the Mir space station.

#### Integrated User Support From Concept to Space Experiment

The MUSC structure is tailored for individual missions in such a way that the various stages of the experiments, such as preparation, in-flight performance, and evaluation are handled successively. For the forthcoming extended Columbus space station missions, where scientific experiments must be performed while the previous ones are being evaluated and the next ones prepared, parallel user support will be required for all three stages simultaneously. A structure to allow this is currently being developed.

The essential functions of integrated user support are:

- discipline- and system-specific user information,
- supporting ground programs,
- mission support, and
- scientific and technical infrastructure.

and these will be briefly described in the sections below.

#### User information

The MUSC is committed to familiarizing new users with the potential and requirements for experimenting under space conditions. For this purpose, it also runs an annual summer school (since 1968) and a specialist library.

Suitable contacts are arranged within or outside the User Support Center to answer technical questions.

The planning, preparation, performance, and scientific evaluation of space experiments are supported by the Ariadne information system. This is the central component of the MUSC data system and is designed as a distributed database information system for processing:

- synopses of previous space experiments (experiment catalog),
- numerical data, in particular measurement data from space experiments,
- bibliographic data such as scientific literature and project documentation, and
- still pictures, graphics, and video sequences.

Ariadne's flexible data structure makes it adaptable to existing and future information structures and extendable to special applications in other space sectors. The MUSC is cooperating with the user centers being developed in Italy, France, and the Netherlands on the creation of a European information network.

#### Supporting Ground Programs

In preparation for the experiments, the User Support Center operates engineering models of the multipurpose installations, which are identical to the onboard units in all their experiment-related functions. These models make it possible to develop and test the proposed space experiments in a series of preliminary trials. In the ground tests, the experimenter concentrates on the actual test sample and test procedure, while the User Support Center adapts the experimental equipment to meet the requirements of the specific experiment. If experiments in human medicine and biology are to be accommodated, there are further tasks. The drafting of a common protocol for several experiments, for instance where human medicine and human physiology are concerned, is worth mentioning here. The individual experiments have to be integrated to keep the stress on the astronaut "guinea pig" at a scientifically and ethically acceptable level and preclude undesirable mutual interference. In biology, the operational and technical/scientific performance of the experiment must be worked out in consultation with the experimenter.

The interaction between permanent installations and experiment-specific equipment, e.g., samples, is tested and optimized during the development of a material sciences experiment. The right experimental procedure is devised and the requisite parameters for the installation control programs determined. This enables the experiments to be conducted largely automatically during the mission. Only in special cases—for example, breakdowns or where the experimenter wishes to introduce changes—is human intervention required during the experiment.

So far, there is much less scope for automating experiments in the life sciences. Moreover, the astronauts play two roles in physiological studies: those of both

researcher and guinea pig. This makes the development of procedures for the astronauts's work particularly important. Working to these procedures and familiarization with the test equipment are at the center of astronaut training at the MUSC.

The ground equipment is kept operational during the mission. In the event of breakdowns on board, the operational status of the in-flight equipment can be reproduced on the ground and the causes of the faults analyzed.

The experimenter has to be able to examine the effect of the different ambient conditions, gravity and microgravity, in otherwise the same experimental conditions. To this end, "1-g" experiments are performed.

For biological experiments, the 1-g reference trials are conducted in parallel with the mission with the same biological species generations. In human physiology, the 1-g reference trials are planned in experimental campaigns during which the ground model is used to determine the astronauts' physiological data before and immediately after the mission. The life science ground systems are installed close to the launch and landing sites.

For an unmanned mission like Eureca (European Retrieval Carrier), which has no permanent telemetry link with the ground, the experimental equipment must operate independently. This requires numerous experiments on the ground to prepare control programs both for the normal procedure and also for system states deviating from the normal.

#### Mission Support By the MUSC

For operational tasks during the mission, a decentralized operating concept is proposed for the space station era, with three levels of responsibility: the experimenter is responsible for the experiment configuration, and a user support center like MUSC for operating an experimental installation. The DLR space flight control center in Oberpfaffenhofen coordinates the operation of the entire European payload.

The DLR is already implementing this concept, which is specially tailored to long missions, at least as far as current or planned missions allow.

For the Eureca-1 mission, MUSC is helping to operate the experimental systems. The MUSC experiment control room processes the experiments' scientific data and the data on the current system status, edits it, and displays it for the scientists and engineers. Experiment system control commands can be transmitted to the systems in orbit via the European control center, ESOC [European Space Operations Center] in Darmstadt. However, the telemetry stations used in Kourou and Maspalomas can only relay the data when the satellite is within the transmission range of their antennae. It overflies each of them within range for five to 10 minutes about five times a day.

Better telemetry links between ground and the orbiting systems will enable the scientists or the user support center responsible for the system to conduct the experiments and operate the experimental equipment interactively during the mission (telescience). Telescience is one of the key uses for the space station.

The MUSC has embarked on a program to develop and use telescience on manned and unmanned missions. Telescience technology was first used to control experiments in the TEXUS program, which uses a high-altitude research rocket to experiment for six minutes under reduced gravity conditions. In a further stage, the DLR has prepared a telescience experiment for the D-2 mission in cooperation with ESA and DARA [German Space Agency]. Here, the scientists themselves interactively control an experiment with the HOLOP holographic interferometer from the MUSC. Using a ground computer with a graphic user interface, experimenter can characterize his experiment reliably and give the requisite commands via interactive graphics. Video images of the processes taking place in the experimental cell can also be transmitted. Voice communication is possible between the experimenter at the MUSC and the astronaut.

In further stages, to be implemented on precursor space station missions, the experimental systems' technical subsystems will also be monitored and controlled interactively from the MUSC. There are a number of prerequisites for the interactive operation of experiments and installations:

- the availability of a rapid data transmission and telemetry system (signal propagation times below two seconds each way),
- experimental systems suitable for telescience operation, allowing flexible intervention in the space experiments without endangering safety,
- the ground control centers must be equipped for the reliable and rapid transmission of data and commands,
- test equipment on the ground, and
- consoles for operating the experiments and the installations in the user support centers.

#### Scientific Infrastructure

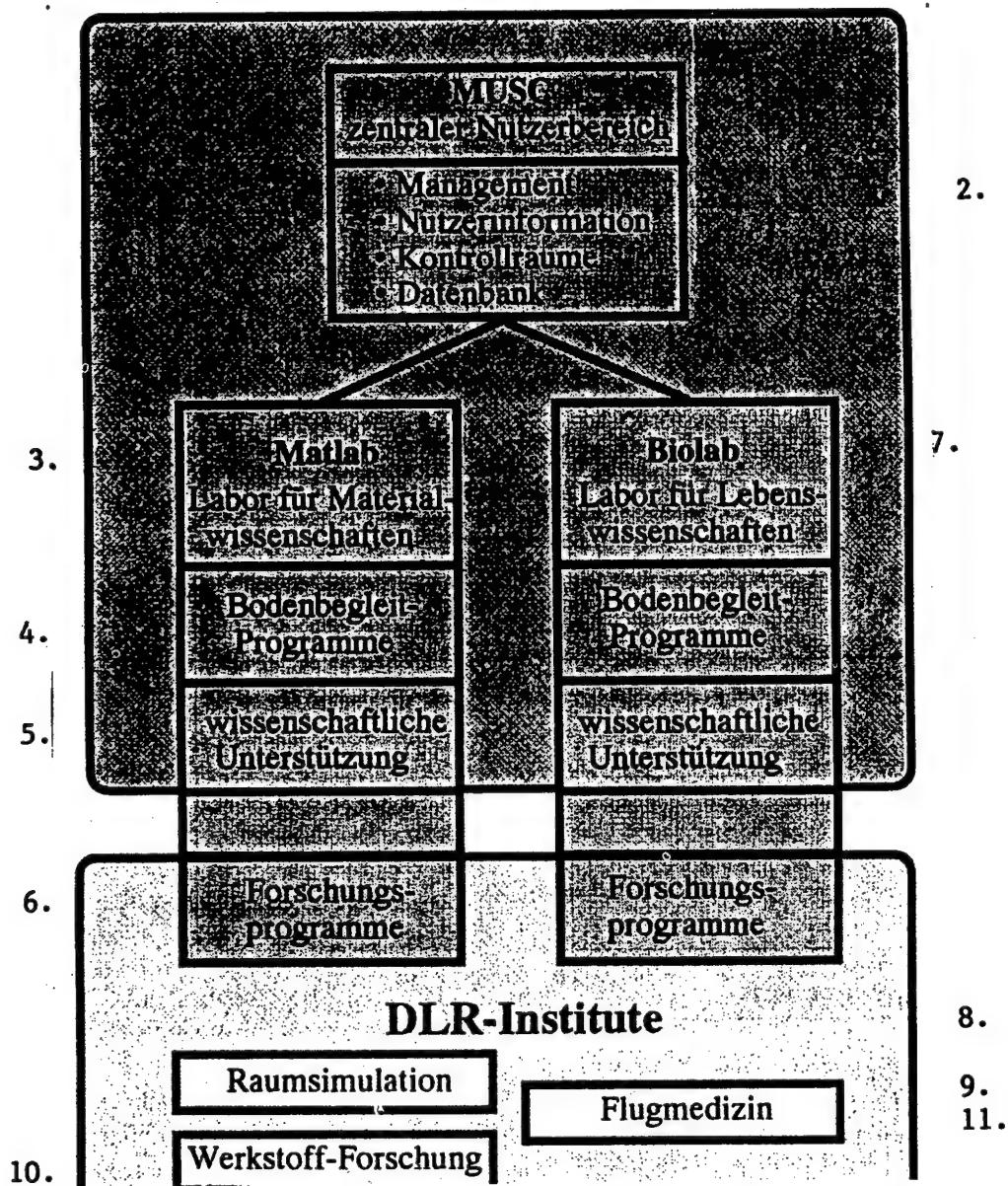
The MUSC's central tool is a computer system that collects, processes, and stores real-time measurement data regardless of the structure of the telemetry data from space, but with fast access for rapid evaluation of the data. This is particularly important for human physiology and medicine, as they generate large quantities of data in a short time that have to be evaluated so that, if necessary, decisions can be made fast, for instance to continue the experiment in space with modified protocols. This computer system was developed with the DLR Applied Data Systems Division on the basis of human physiology requirements (Anthrorack). It is currently already being used for two further payload elements for

the D-2 mission (HOLOP, MEDEA). Further development for new experimental systems (e.g. TEMPUS, NiZeMi, Mir installations) is in hand or planned.

Regardless of the mission projects, the MUSC's users make use of its equipment for analyses, pretests for future experiments, simulation calculations, etc., working with scientists from the member research institutes, who are able to pass on the experience gained from their own microgravity experiments.

### Outlook

The DLR's MUSC user support center gives all interested, from science and industry, access to its expertise in space experimentation technology, thus providing a facility where the space user can concentrate on his scientific or technical problem, while the MUSC largely takes care of the problems specific to space. The MUSC offers integrated user support for space experiments during experiment preparation, performance, and evaluation.



Key: 1. MUSC central user area 2. \*Management \*User information \*Control rooms \*Database 3. Matlab Material Sciences Laboratory 4. Supporting ground programs 5. Scientific support 6. Research programs 7. Biolab Life Sciences Laboratory 8. DLR Institutes 9. Space Simulation 10. Materials Research 11. Flight Medicine

Providing support for the scientific and commercial use of the space station is one of the MUSC's main tasks in the medium term. The MUSC will also make its services and abilities available for experiments on carriers like TEXUS, Mir, or other international joint flights. Programs not involving microgravity will therefore also increasingly benefit from the MUSC's experience. In particular, there are plans for the range of services offered to external scientists to include the future tasks of a laboratory that will simulate and study processes on planetary surfaces.

As a national user support center, the MUSC has central responsibility for user support tasks in the German space program. This includes the duty of integrating existing expertise from universities, scientific space centers, and industry so as to use the national potential to the greatest advantage.

As a model user support center for the future space station, the MUSC has a key role in ESA as a payload operations center at subpayload (facilities) level. The MUSC has set the pattern for similar centers in Italy (MARS [Microgravity Advanced Research and Support Center]) and France (CADMOS [Support Center for the Development of Microgravity and Space Orientations]), with which cooperation agreements have been signed. The cost of the operational work that the MUSC performs for external users is borne by the national or international funding bodies financing the respective experimental equipment.

The MUSC's interdisciplinary user information and mission support facilities are combined in the MUSC center user area. The specialized supporting ground programs and their infrastructure are directly linked to the three specialized institutes.

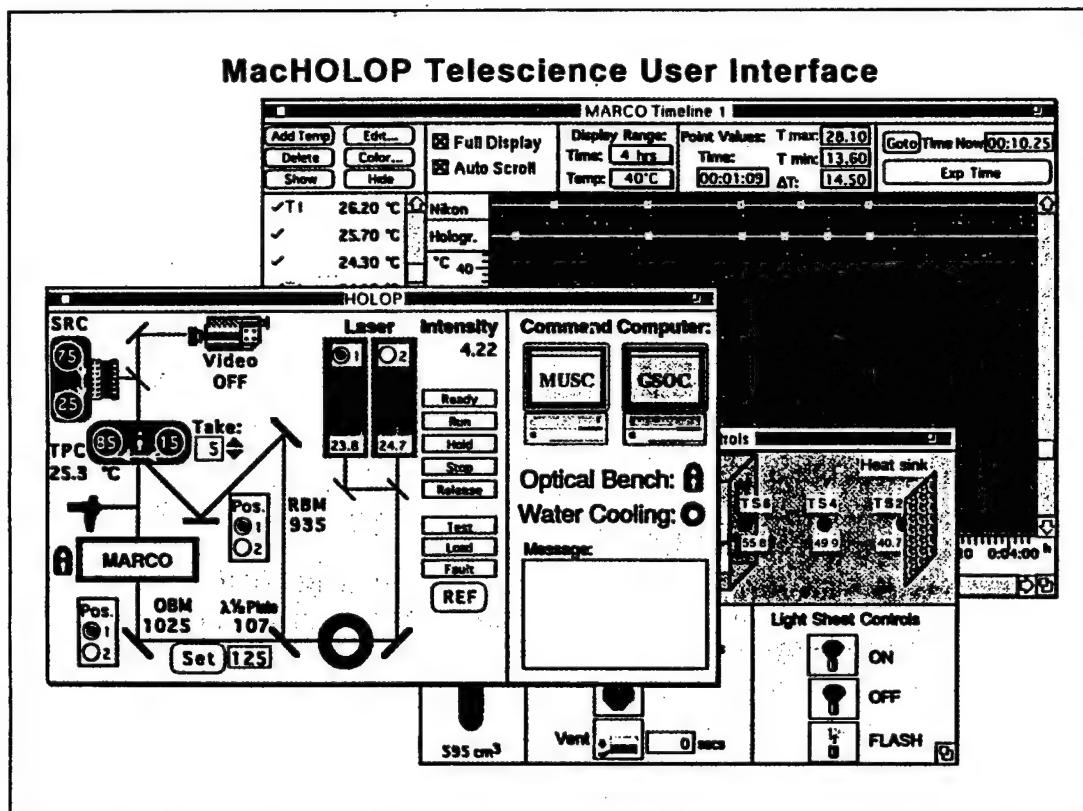


Fig. 4 Key: 1. The user interface allows rapid analysis of experiment status for the interactive performance of a HOLOP holographic interferometer. Commands are sent by simply clicking on the corresponding symbols.

Table 1. MUSC User Support Programs

Experimental System	Mission	Type of Experiment	Number of Experiments
Anthrorack	Spacelab D-2	Human physiology	20
Biolab	Spacelab D-2	Biology, botany and zoology	14
HOLOP	Spacelab D-2	Physical chemistry and fluid physics	4
MEDEA	Spacelab D-2	Material sciences	9
Matlab	Spacelab D-2	Material sciences	12
AMF	EURECA-1	Semiconductor crystal growth	5
ERA	EURECA-1	Radiation biology	
MFA	EURECA-1	Solidification of alloys	5
PCF	EURECA-1	Protein crystal growth	6
SGF	EURECA-1	Crystal growth from solution	4
HPT	EURECA-1	Adsorption near the critical point	1
NiZeMi	Spacelab IML-2	Microscopic observation of life and material science samples at variable acceleration	8
TEMPUS	Spacelab IML-2	Contactless smelting and solidification of metallic samples	8
CSK	Mir	Five-zone heating system for crystal growth and solidification experiments	8

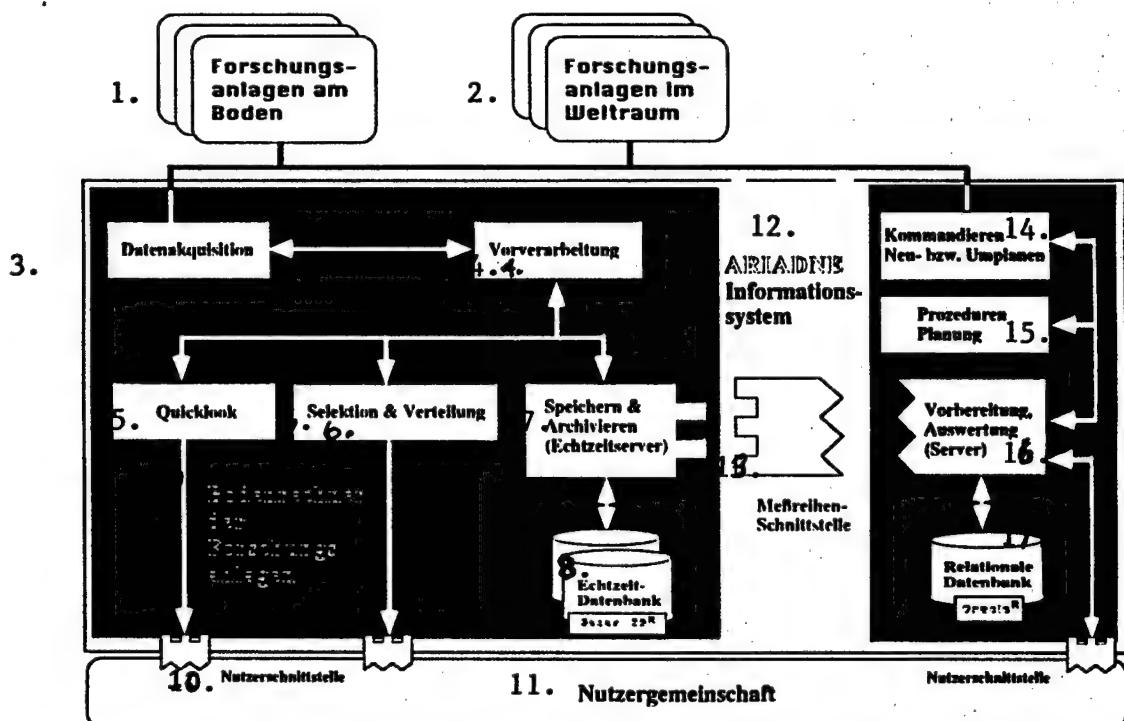


Fig. 5 The Ariadne information system and ground computers in the experimental systems linked to it supply the MUSC experimenters and external users with, for instance, real-time and archive data. The information system's coordination function provides consistent data management even in geographically and functionally distributed computer architectures.

Key: 1. Research systems on the ground 2. Research systems in space 3. Data acquisition 4. Preprocessing 5. Quick look 6. Selection and distribution 7. Storage and archiving (real-time server) 8. Real-time database 9. Research systems' ground computer 10. User interface 11. User community 12. ARIADNE Information System 13. Measurement array interface 14. Commands New and or revised plans 15. Procedures Planning 16. Preparation Evaluation (Server) 17. Relational database [Oracle R]

**ESA Approves Polar Earth Orbiting Satellite**

*93WS0409E Paris ESA PRESS INFORMATION  
NOTE in English 26 Mar 93 pp 1-5*

[Text]

**Earth Watch—The Next Step**

There is growing worldwide concern over the potential of man's activities to damage the earth's environment. At the same time there is increasing realisation that our scientific understanding of the processes involved in creating the overall global environmental system is far from complete. This has led governments to support projects to monitor the global environment and to improve the confidence with which changes can be predicted.

Already ERS-1, the first European Remote Sensing Satellite, launched in 1991, is providing exciting new data, opening up new avenues of research and new approaches to critical problems. ERS-2 will ensure continuity, which is vital since a full understanding of the environment requires databases to be built over periods of more than a decade.

It is with this in mind that the governments of the ESA Member States wholeheartedly approved another ESA polar orbiting satellite, ENVISAT-1, to be launched in 1998. ENVISAT-1 will continue the mission of the ERS satellites with next-generation instruments and at the same time enhance its environmental component, most notably through a brand-new atmospheric sciences instrument package.

These ESA satellites can be seen as part of the response to the international earth and environmental sciences community, who are aiming at ambitious objectives through projects under the International Geosphere-Biosphere Programme (IGBP) and the World Climate Research Programme (WCRP). Fundamental to these programmes is the provision of global observation data to identify processes and validate models. Such data are also needed to monitor the state of the earth system and to detect changes. These requirements need long-term continuity, entailing the provision of a whole series of satellites rather than on-off endeavours.

These issues are all addressed in the earth observation programme undertaken by the European Space Agency, ESA. Coordinating fully with the other space-faring nations, ESA has chosen to play an important role in monitoring the earth/atmosphere system thanks to its ERS and ENVISAT series of satellites. Within this context the mission objectives of ENVISAT-1 include:

- continuity of ESA's current ERS-1/2 remote sensing projects in which the emphasis is on the observation of oceans and ice and their interaction with the atmosphere,
- new climate studies, including atmospheric chemistry.

**Continuation and Extension of the ERS Missions**

Here the most important variables to be observed are surface features, global wind and wave fields, ocean colour and sea surface temperature. Some of these are vital inputs to climate models. They will all be measured by ENVISAT-1, with its extended capabilities as compared to ERS. The key instruments covering continuation of ERS include:

1. The Advanced Synthetic Aperture Radar (ASAR), with dual polarisation, 400 km swath capability and a set of viewing angles.
2. The Medium-Resolution Imaging Spectrometer (MERIS), a 1,000 km swath imaging spectrometer (visible and infrared) used for ocean colour monitoring.
3. The Advanced Along-Track Scanning Radiometer (AATSR), a 500 km swath radiometer (in infrared and visible) for precise sea surface temperature measurements and observation of land characteristics.
4. The Advanced Radar Altimeter (RA-2), for determining wave heights and wind speeds globally. By also determining the variation of the distance between the satellite and the ocean surface the RA-2 will, in conjunction with an additional instrument devoted to precise orbit determination, give unique information on ocean circulation.

The unique opportunities for earth sciences, meteorology, oceanography and applications opened up by ERS will therefore be continued well into the next century. They also address biophysical characterisation of the oceans and coastal zones and additional information over land complementing data from optical and meteorological satellites.

**Climate Studies and Atmospheric Chemistry**

Atmospheric dynamics, coupled with the action of trace gases, are main drivers of climate. For studies of the trace gases the limb and nadir viewing chemistry sensors on ENVISAT-1 will enable many of the key chemical species to be observed globally and with high precision, including ozone and the complete family of oxides of nitrogen. The key instruments for atmospheric chemistry are:

1. The Michelson Interferometer for Passive Atmospheric Sounding (MIPAS), a limb-sounding interferometer measuring the mid-infrared spectrum in the upper troposphere and the stratosphere.
2. The Global Ozone Monitoring by Occultation of Stars (GOMOS) instrument, a limb-viewing spectrometer observing ozone and other trace gases in the stratosphere, at high vertical resolution.
3. The Scanning Imaging Absorption Spectrometer for Atmospheric Chartography (SCIAMACHY), a limb- and nadir-viewing imaging spectrometer observing a wide range of trace gases.

Together they form a unique combination to monitor and study the trace gas species involved in climate change, global warming and ozone depletion. Also of particular importance is the earth's radiation balance. Here, the data from SCARAB, a broad spectral band earth-radiation radiometer, will prove particularly useful.

## **ENVISAT En Route for a 1998 Launch**

ENVISAT-1 will be Europe's largest earth observation satellite, circling the earth in a sun-synchronous orbit around the poles, once every 100 minutes. Its special orbit allows it to view portions of the earth's surface at the same time every day.

ENVISAT-1 will be the first mission to use the ESA Polar Platform developed as part of the Columbus programme to be the workhorse on which Europe's future ambitious earth observation missions will be based. ESA awarded the prime contract for the development of ENVISAT-1 to British Aerospace, which has been involved in this programme since the mid-1980s.

To be put into orbit an an Ariane launcher in 1998, ENVISAT-1 is bound to become a key element of the worldwide effort to better understand and monitor the earth globally from space.

## Arianespace's Civil Market Analyzed

93WS0412A Paris LE BULLETIN DU GIFAS  
in English 25 Feb 93 pp 1-4

[Text] The term "commercial market" mainly covers the demand from telecom, earth observation, weather and scientific satellite operators. This includes all private operators—national and international—and non-military public operators. ARIANESPACE makes a distinction between the "civil market" and the very different "military market," where needs are often diametrically opposed. The following summary concerns the characteristics of the "civil market," factors likely to drive change and trends, as well as prospects for the next 10 years.

### **Current Market Characteristics**

To better understand today's civil market, which corresponds to launches scheduled over the next three years (i.e., launch companies' backlogs), it helps to study activities in the past two years.

The table below illustrates the operations of the world's launch systems in the past two years, excluding military satellites, the yet uncommon microgravity payloads and satellites weighing less than 500 kg. Of the 43 satellites successfully placed into orbit, ARIANESPACE launched over 50 percent—and at a regular rate. The other six launch systems—Atlas, Delta, H1, Titan, Long March and the US Shuttle—placed 21 satellites into orbit.

## Number of Civil Satellites Launched in the Past 24 Months

A high average of 23-24 satellites per year was launched for two consecutive years. It is interesting to note that Ariane and Delta alone are responsible for two-thirds of these launches, with a 100 percent success rate. Atlas and Long March have performed a total of only four successful launches and encountered four failures.

In the short term, i.e., for a launch within the next three years, customers have already contracted for the launch of 54 "civil" satellites, 81 of them with ARIANESPACE, as shown below. [as published]

### Firm “Civil” Contracts

Ariane	57.4 percent
Atlas	25.9 percent
Delta	13 percent
Long March	3.7 percent

### Three Major Applications

The civil market mainly comprises three major applications: telecommunications (three-quarters) and, in equal parts, earth observation and weather applications on one hand, and scientific programs on the other.

Today, the world's space telecommunications system (excluding the CIS) is composed of 94 operational satellites (93 in 1991). This represents a capacity of some 2,000 transponders in orbit in the six following zones:

—Europe, a zone covering many countries and many languages, now reaches maturity. Taking into account spacecraft already planned for network replacements and additions, Europe will soon have 380 transponders, or one transponder per million people.

—The United States shows remarkable stability, with an average of 500 to 550 operational transponders. This zone mainly uses the C band, with the Ku band representing only one-third. Nearly 70 percent of applications concern TV program distribution to cable networks.

- The Asia-Pacific zone is the most dynamic financially, but only four countries have space telecommunications: Japan, Australia, Indonesia and Hong Kong, with a total of 310 transponders.

—Central America and South America have already planned replacements (Brazil and Mexico); Argentina also seems willing to set up a space telecom program.

- The Far East and the Middle East are characterized by two operational programs (India and Arab countries) and two programs which are slow to come to fruition (Iran and Israel).

—International organizations INTELSAT and INMARSAT are finalizing major decisions for replacing and increasing their capacities up to the end of the decade. U.S. private operator PANAMSAT, with one operational satellite today, is trying to gain a share of this international market.

### Throughout the World (Source: Airclaims.)

Earth observation and weather forecasting call upon government programs. Earth observation services are provided by Spot, Landsat, MOS and ERS. A world weather watch is assured by Meteosat, GOES, NOAA and GMS, and partially by Insat and Meteor. This market doesn't attract private investors.

Scientific programs are more and more international and require long preparation periods of five to 10 years. A few national projects using small satellites weighing a few hundred kilograms are under study.

#### The Main Trends

Certain factors may have an impact in the medium and long terms, after the year 2000. These factors include:

- Telecom satellite mass has gradually increased from PAM-class satellites in the 1980s, through 2.2-2.6 ton spacecraft, to today's satellites weighing over 3 tons. Satellite liquid propulsion systems and launch vehicle performance have encouraged heavier satellites. Payload capacity has also increased, and design life is now 12 or even 15 years, a blessing for investors. The increase should stabilize at approximately 3 tons (+/- 20 percent), partially because of the likely appearance of ionic propulsion. This satellite class provides a good basis for a maximum load factor on Ariane 5.
- The integration of data compression techniques could become generalized in the medium or long term and allow double or triple transponder capacity. Will the number of television channels double or will we see half the number of satellites?
- Will the concentration of telecom satellite operators in the United States (only four operators today) also

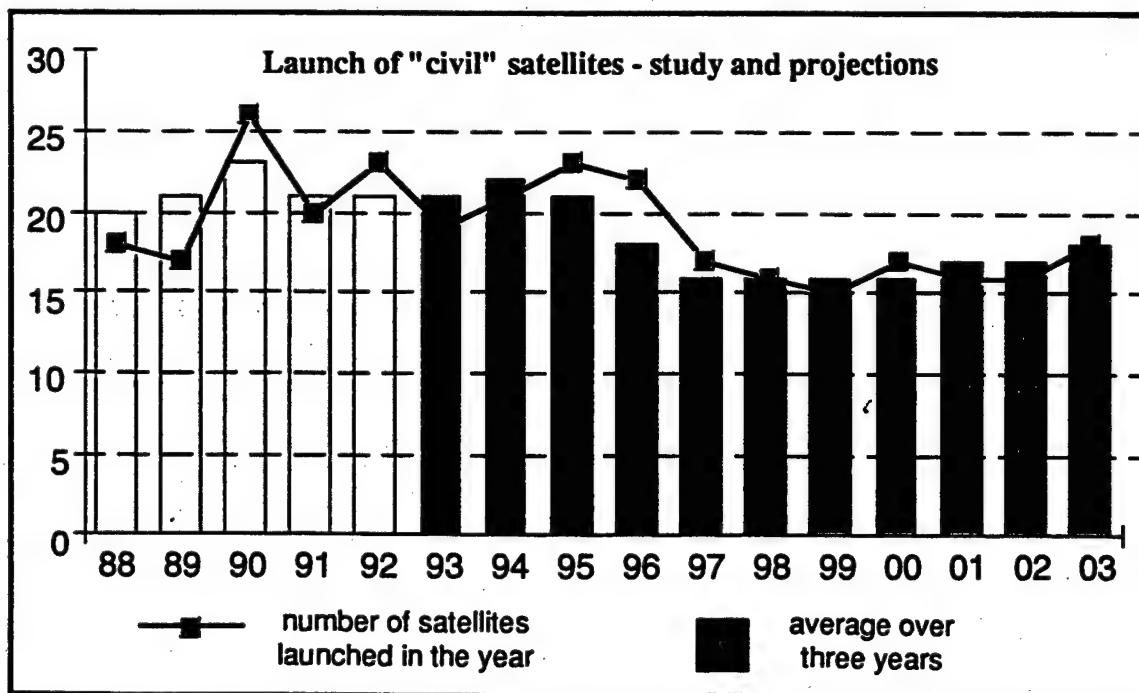
happen in Europe, with a view to higher profitability, given the coming of a "Single Europe" and increasing liberalization?

- New applications generated by "mobile" communication and position-determination needs may find a solution based on big satellites or to the contrary, constellations of satellites weighing a few hundred kilograms. Will these "Leacoms" create a revolution among satellite operators and in particular among telecom organizations who are still mostly owned by public authorities, in spite of the liberalization trend?
- The arrival of new launchers in the field is disturbing the market. Is global demand sufficient to feed the supply, when the supply is increasing by leaps and bounds, goes through failure phases (Atlas and Long March) and experience highly, media-oriented events (LOCKHEED and KHRUNICHEV with Proton)? One hears the "sirens' song" more and more often, but in the long term, investors will remain cautious and look for the best trade off between global service quality and price.

#### Market Prospects

In the short term, 1993-1995, the market is already a known quantity, since it corresponds mostly to backlogs (54 satellites) and the results of current negotiations. Launch service activities will remain high, with an average of over 20 satellites to be orbited per year.

In the medium term, 1996-2000, ARIANESPACE confirms projections made in recent years, which showed an overall decrease in launch activities due to several factors, including:



- The European and U.S. satellite systems will be completed and/or replaced between 1993 and 1997-1998. These two zones, equipped with new satellites, will be enough to satisfy market needs.
- International organizations have already made decisions to satisfy demand up to the end of the decade and most of their new satellites should be operational by 1997/1998.
- The Asia/Pacific area, which should be the most active, will not totally make up for less active zones (Europe, U.S. and international systems).
- Grouping or concentration of satellite operators will tend to encourage investments in heavier satellites with larger payloads and more transponders. A launch carried out in 1997-1998 will bring much more operational capacity than a launch in the short term. The slight slowing down of launch activities should result in higher global communication capacity, easily satisfying the increasing demand.
- Developing countries have a true need for communications but many projects will be slowed down for lack of financial resources.

In the long term, after 2000, ARIANESPACE tries to anticipate general trends, taking into account an upturn in demand due, in part, to the launch of new products (microgravity) and structures (platform) into space.

The graph below illustrates market trends:

- from 1988 to 1992, an average of over 20 satellites per year;
- from 1993 to 1995, a sustained rate of over 20 satellites;
- from 1996 to 2000, a slight decrease, but smaller than anticipated last year;
- after 2000, a new upturn in activities and a stabilized rate of 17-18 satellites per year.

#### France: Falcon 2000 Commercial Aircraft Reviewed

93WS0412B Paris *LE BULLETIN DU GIFAS*  
in English 11 Feb 93 pp 1-4

[Text] Dassault Aviation's Falcon line has claimed 15 percent of the world market for jet-propelled executive aircraft with 1,100 aircraft sold in 60 countries during the past 30 years. In all, 7,000 aircraft of this type are flying today, as many as commercial carriers.

Each year, 250 to 300 new jet-powered executive craft are sold throughout the world and these aircraft log an average of 450 to 500 flight hours annually. In terms of value, the triple-jet Falcon 50, Falcon 900 and the new twin-jet Falcon 2000 represent over half the total market for their particular slot.

In reply to a demand from customers for a twin-jet with transcontinental capability (5,560 km range) and accommodations for eight to 19 passengers, Dassault Aviation has designed the Falcon 2000. The first model, both a development aircraft earmarked for certification and the

first production unit, was officially unveiled at the Company's Bordeaux-Merignac premises on 10 February 1993.

Already, 50 options have been received for the Falcon 2000 from customers in 12 different countries.

#### Comfort and Performance

The twin-jet Falcon 2000 has a wide fuselage accommodating from eight to 19 passengers. It has the same outside diameter, 2.50 m, and same cabin height, 1.87 m ceiling, as the Falcon 900. The 5.83 m passenger cabin authorizes many seating solutions and partitioning into two and a half compartments. For example, one salon may be laid out in front with four seats, another two-seat salon in the rear and a three-seat convertible couch-bed.

With a total pressurized cabin and in-flight accessible baggage hold volume of 33 m<sup>3</sup>, the Falcon 2000 weighs-in between the Falcon 900 and the Gulfstream IV on one hand, all other business aircraft on the market, on the other.

Performance is due to far-reaching studies in aerodynamics and motorization.

General design of the Falcon 2000 (wing, fuselage, fin, pod-engine attachment, etc.) has been fully optimized. The engine was chosen for optimum drag and fuel consumption and for greatest range. This meant probing such parameters as specific consumption, reliability and maintenance, noise, development capacity and costs. These considerations led to the selection of the General Electric-Garrett CFE 738 in April 1990. With this motorization, the Falcon 2000 will be able to operate in hot atmosphere and from high altitude fields while covering transcontinental legs of 3,000 NM (5,560 km) at Mach 0.8.

#### Catia Computerization To Obtain the Best Cost-to-Design Ratio

With the high performance tools available today it has been possible to limit development costs while retaining the sales price of \$13.950 million per aircraft.

Dassault Aviation and Alenia have used Catia software, a system developed by Dassault for the computer-assisted (CFAO) design and production of Falcon 2000 structural components. All primary parts and tooling have been created from shapes obtained using the Catia system.

This CFAO, computer-assisted method has done away with the traditional building of a full-scale mockup for positioning fittings. Now, all line paths and wiring plans are determined by computer. The computer model was directly used as a basis for lines and pipes and for placing supports. All intermediate phases have been eliminated and parts fit-in perfectly right from production of the first fuselage.

The Catia method will also be used for devising production layout of fittings on the Falcon 2000.

**Customer Satisfaction as a Primary Guideline**

The Falcon 2000 has been built to customer desiderata. These requirements were confirmed by investigations conducted by Falcon Jet Corporation in 1987 and 1988. Results indicated that:

- the aircraft would have to be able to cover transcontinental distances (3,000 NM or 5,560 km). This distance corresponds to connections such as Miami-Seattle (2,400 NM or 4,450 km) or Boston-San Diego (2,270 NM or 4,200 km) which can now be flown regardless of wind conditions,
- it would have to offer comfort conditions comparable to those of the three-jet intercontinental Falcon 900,
- it would have to offer lower operating costs (objective -30 percent) than comparable aircraft currently flying. This aim has been met through the low consumption of the CFE 738 turbojet and an overall five-year guarantee.

Such are the desiderata of customers in Europe and in the rest of the world. The basic price tag on the Falcon 2000 in accordance with 1990 economic conditions is \$13.950 million. To date, 50 options have been received from 12 different countries.

**European Cooperation**

The decision to build the aircraft under a cooperation arrangement is allied to that of obtaining the best possible product.

Much thought has gone into the establishment of a conventional type association involving American and French equipment manufacturers, such as Collins for basic avionics and Sextant Avionique for instrumentation and engine monitoring. Dassault Aviation does not buy individual off-the-shelf equipment, but invites equipment manufacturers to participate in system certification procedures.

In 1990, the Italian firm Alenia was chosen to take a 25 percent stake in the program. The reasons governing this choice include Alenia's high level of technology, work methods adapted to international cooperation and competitive prices.

The cooperation plan is as follows: Alenia invests all funds necessary for development of engine-pods, thrust reverser and the rear fuselage section (T 45) of the Falcon 2000, then, Dassault Aviation buys these parts from Alenia. Prices are quoted in dollars so that exchange fluctuations are equally shared.

Alenia has made over prime contractorship in this program to its Turin plant taking on, as subcontractors, its subsidiaries Rinaldo-Piaggio for section T4, and the Dee Howard Co. of San Antonio, U.S., for the thrust reversers.

All plants operated by the Dassault Aviation group participate in production of the Falcon 2000. All Falcon 2000 wings will be made at Martignas and all aircraft will be assembled at Mérignac, major production center for this program. The first aircraft, without commercial fittings will leave the production line at Mérignac during the second half of 1994. Production rate will gradually be stepped-up.

At present, the market for the Falcon 2000 is estimated at 300 units for the coming 10 years.

Maiden flight is scheduled for the spring of 1993. The aircraft will be shown at the Paris Air Show in June of this year. European and American certification will be obtained around the end of 1994 and lead-off deliveries to customers will take place early in 1995.

Setting to flight standard and interior fittings of all Falcon 2000s sold outside the American and Pacific zones will be done at Mérignac. Falcon Jet Corporation, the subsidiary of Dassault Aviation in the United States is in charge of sales and cabin fittings of the Falcon in the above-mentioned zones.

**"All Weather Landing" Option Available for the First Time**

During the initial phase, Dassault Aviation will have the Falcon 2000 certificated for minimum visual runway distance of 700 feet (210 m) owing to the use of a HUD (Head Up Display).

The pilot will have a system at his disposal which flashes all necessary piloting data at eye level. The HUD will enhance safety during approach phase regardless of weather conditions.

Later, it will be possible to combine the HUD with an automatic landing system which will optimise system performance while allowing for forward visibility of 500 ft (150 m), which complies statistically with most instances of fog.

Aside from advantages for poor visibility landings, the HUD is precious in certain delicate piloting phases in which it improves safety by means of the data flashed at pilot eye level.

Avionics of the new twin-jet include a Collins four tube EFIS Pro Line 4 system and liquid crystal engine instrumentation by Sextant Avionique. The standard aircraft also include an autopilot, a color weather radar and an FMS (Flight Management System). Optionally, the aircraft can be provided with an MLS (Microwave Landing System), a communication via satellite (SATCOM) system and an anti-collision (TCAS) system.

**Outside Dimensions**

Overall length	20.23 m
Height	6.98 m
Span	19.33 m
Surface	49 m <sup>2</sup>

**Inside Dimensions**

Cabin length	7.98 m
Cabin height	1.87 m
Volume of baggage hold	4 m <sup>3</sup>

**Weights**

Empty weight equipped	8,855 kg
Maximum take-off weight	15,875 kg
Fuel capacity	6,865 l

**Performance**

VMO	350 kts
MMO	M. 0.85
Range	5,560 km (8 pax, NBAA/IFR, M. 0.80)
Maximum certified altitude	14,330 m
Landing run	780 m (8 pax, IFR, SL, FAR 91)

**Netherlands Researching Earth Observation Technologies**

93BR0424 *Rijswijk POLYTECHNISCH WEEKBLAD*  
in Dutch 19 Feb 93 p 5

[Article by Joris Janssen Lok: "TNO [Netherlands Organization for Applied Scientific Research] Wants To Become One of the International Leaders in Earth Observation"]

[Text] Observation of the earth from space has from the beginning been the domain of the superpowers. The U.S. and Russia have their spy satellites. The French, the Germans, and the British play a leading role in European activities. But the tiny Netherlands is also catching up. TNO [Netherlands Organization for Applied Scientific Research] is developing, mainly with defense funds, a radar technology for aircraft which will be able to analyze image details which will only be accessible with satellites by the beginning of the next century.

TNO's research into earth observation technologies is specifically focused on remote sensing using synthetic aperture radar (SAR) technology. This technology provides radar images of the earth's surface of almost photograph quality under all weather conditions. Engineer Peter Hoogeboom, head of remote sensing at TNO's Physical and Electronics Laboratory in The Hague, emphasizes that TNO would like to attain an internationally leading position in the area of SAR image processing. "It concerns in particular the processing of raw radar data originating from the European Space Agency's (ESA) ERS-1 [European Remote Sensing Satellite] earth observation satellite."

The laboratory would like to set up a space image processing and archiving center. "Such a center could

grow into a fully fledged Processing & Archiving Facility (PAF) for remote sensing, recognized by ESA," said Hoogeboom.

The TNO laboratory is interested in this status because it is itself involved in developing new techniques for the processing of SAR radar images.

"For that, we need raw, unprocessed data from ERS-1," continued Hoogeboom. "At the moment, we are dependent on the standard, processed images which we receive from centers abroad."

**The Hague Laboratory Wants to Score**

With its new technologies, The Hague laboratory wants to score with the Western European Union (WEU) and the European Community. TNO is in fact a member of a consortium which is to build a new satellite center for the WEU in Torrejon, Spain. TNO is also involved in the bidding process to supply the SAR processing system for EARSEC (European Airborne Remote Sensing Capability), a project run by the EC's Joint Research Center (JRC) which will implement a Danish SAR earth observation system for aircraft.

The most tangible SAR project at TNO is Pharus, a synthetic aperture radar which should be operational by 1994. This project is funded by the Ministry of Defense together with the multi-departmental Policy Commission for Remote Sensing. Also involved are the National Air and Space Laboratory (NLR), the Technical University of Delft, and the National Institute for Aircraft Development and Space Travel.

**Only Four Meters Across**

Pharus will transmit on the C-band at a frequency of 5.3 GHz (wavelength of 5.6 cm.). This frequency is also used by ERS-1, launched in 1990; ERS-2, to be launched in 1994-95; and Envisat [Environment Satellite], which will be launched at a later date.

This is the reason why Pharus fits so perfectly into ESA's present family of earth observation satellites. Operating from space in the C-band, ERS-1 obtains a resolution of approximately 25 meters. "When Pharus goes up in 1994, it will even be able to see objects only four meters across," said Hoogeboom. The difference in resolution is mainly because Pharus, which will be mounted under an aircraft, will remain much closer to the earth's surface than ERS-1, which orbits at a height of 800 km. "This sort of radar resolution is about what you can expect from future satellites. Pharus, therefore, will enable us to gain the necessary experience with what will soon be possible on a large scale using satellites."

This is why for the future Envisat an Advanced SAR (ASAR) with an active antenna is being developed. ESA and TNO expect that post-Envisat satellites will be equipped with earth observation radars operating in the X-band (8-10 GHz, wavelength of between 3 and 3.75 cm). They are referring to the successor to Envisat,

planned to be ready by 2010, but whose construction, let alone launch, has not yet even begun (slated for 2000).

### Better Resolution

The development of ASAR radar for the Envisat satellite, which is led by the French-British concern Matra Marconi Space, will benefit from the Netherlands Pharus project. Hoogeboom again: "In 1995, when we are flying around with Pharus, we will be getting images from our aircraft which will be very similar to those soon to be available with ASAR. The difference in altitude between an aircraft and a satellite will then be compensated for by the better resolution which ASAR will be able to achieve."

At present, Pharus is in the construction stage and will be ready by the end of 1993. Test flights will take place during 1994. TNO has already gained experience with a prototype system called Phars, which has only eight microwave modules (Pharus has 48). Test flights were made with Phars in 1990 and 1991, suspended under the NLR's Swearingen Metro II test aircraft. The same aircraft will be used for Pharus, although Hoogeboom would prefer to see the (faster) Cessna Citation jet aircraft being used, which was purchased last year by the Technical University of Delft together with the NLR.

### A340 Flight Simulator in Place at Berlin Technical University

*93MI0436 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 3 Mar 93 p 4*

[Text] From April onwards, a complete Airbus A340 flight simulator will be in place at Berlin Technical University for research and development purposes.

It is a faithful imitation of the cockpit of the latest aircraft developed by the European Airbus Industry consortium. The Airbus A340 is a four-jet long-haul aircraft capable of carrying up to 260 passengers over distances up to 13,000 km. Lufthansa took delivery of the first aircraft of this type at the beginning of February, and it will enter scheduled service on the Newark run on 15 March.

### Critical Situations in Test

The Airbus A340 flight simulator provides realistic simulation during the flight run of all the operations performed in the cockpit. Critical and abnormal situations and emergency procedures, such as those carried out in the event of an engine catching fire, a fire in the cabin generating smoke, and system failure can be simulated safely and repeatedly, thus preparing the trainee pilots for any eventuality that might arise during a flight.

The flight simulator also comprises a visibility simulation system for added realism, thus guaranteeing a faithful simulation of the view from the cockpit over the landscape, particularly of the runway used during approach and landing. The full range of meteorological conditions, from broad daylight and clear visibility to

fog and darkness, can be simulated. About 40 different airports are currently stored in the system, so the approaches to Frankfurt, Berlin, Hong Kong, and other cities can be practised one after another. A motion simulator keeps the 13-tonne imitation cockpit constantly in motion, regardless of flight status, and communicates the sensation of actual flight to the pilot.

The simulator is operated by the Berlin Flight Simulation Center GmbH at the Technical University of Berlin, in which Lufthansa holds a 50-percent stake. The other shares are held by German Aerospace Airbus, the German Aerospace Research Institute, and the equipment manufacturer.

### Italy's Laben Develops On Board Data Handling Systems

*93MI0460 Milan HIGHTECH ITALIA in Italian Jan/Feb 93 pp 22-29*

[Article by Fabio Gariani: "Not Just Space"]

[Excerpts] In Italy, in the outskirts of Milan, the aerospace company Laben (Nuclear Electronic Laboratories), which forms part of the Alenia Spazio company of the IRI [Institute for the Reconstruction of Industry]-Finmeccanica group, is playing a leading role in the conquest of space. Laben has constructed electronic components and various types of hardware that are installed on the different types of probes and satellites of long-term scientific programs (one example being the ESA [European Space Agency] Giotto space probe that in March 1986 computed the historic "close encounter" with Halley's comet). [passage omitted]

Laben has made significant economic investments in new researchers, specialized personnel, advanced instrumentation, and innovative verification and testing equipment for its laboratories, as well as in ESA, National Space Plan (NSP) and ASI (Italian Space Agency) programs. As a result, the high technology applications of Laben instruments have continued to expand into sectors that were hardly covered at the beginning (environmental monitoring, electronics and components, data acquisition and transmission, assembly and checking of on-board hardware, quality assurance, remote sensing via satellite, meteorology, microgravity and materials science, the identification of new resources on earth, interplanetary exploration etc.) [passage omitted].

### Interplanetary Probes, Satellites, Electronics: In One Word, The Future

[Passage omitted] The technological spin-offs of its experiences, matured initially on the laboratory test benches, and then in flight in interplanetary space, allowed Laben to transfer its know-how to the earth and space fields afterwards. Other technological successes in the astronautical field have been (some are still under way) the Ulysses probe which, after having passed the planet Jupiter twice, has left the ecliptic plane and is travelling

toward the still unexplored polar regions of the sun, the Tethered TSS-1 satellite that flew aboard the Atlantis space shuttle last summer and was guided by our astronaut Franco Malerba, the Eureca [European Retrievable Carrier] that will be retrieved in a few months by a mission from NASA and is designed for experiments in microgravity and materials science, the ERS-1 [European Remote Sensing] environmental satellite and the forthcoming ERS-2, Lageos and Lageos-2, etc.

#### **Lageos and IRIS [Italian Research Interim Stage]: Two New Steps Ahead**

But the technological course of Laben has not ended with these missions. Lageos-2 is an example.

It is a satellite of the passive type, has a spherical shape with a 60-cm diameter, and a surface covered by 426 retroreflecting prisms.

An international network of observatories, including the ASI Space Geodesy Center at Matera, constantly send very short impulses of laser light to the satellite in orbit, which reflects them and sends them back to receiving stations on earth.

By using Lageos-1 (launched and put into operation in 1976) and the recent Lageos-2 simultaneously, the international scientific community is able to obtain in an appreciably short time a noteworthy mass of data that will be useful in improving our understanding of, and quantifying, phenomena such as the movements of the earth's crust, the speed of rotation and gravitational field of the earth, tides, the length of the day, etc.

The information obtained on the movements of the tectonic plates, for example, will be particularly useful in monitoring areas of high seismic activity.

Alenia Spazio was the project leader of this program, which was launched and developed in a context of mutual cooperation between NASA and the Italian Space Agency.

Laben (which, as already mentioned, is part of the Alenia group) participated in the construction and testing of two important instruments used during the launching stage:

- the TBS (Telemetry and Beacon Subsystem), the subsystem for telemetry and remote control that supplies information on the entry into orbit of the system;
- the LESU (Lageos Electric Sequencer Unit), an electric sequencer that is designed to regulate the ignition sequence of the motor and the release of the satellite.

The setting up of the new IRIS launching system, the control electronics which have also been constructed by Laben, was equally important.

IRIS consists of two sections, the ASE (Airborne Support Equipment) designed for the launching system with a rotating table that can be reused and is stored in the

loading room of the space shuttle and the ISS (IRIS Spinning Stage) propulsion module that houses the satellite to be launched into orbit (this latter being designed by the Snia-Bpd company).

The entire IRIS satellite is stored in the hold of the space shuttle and taken from there to be positioned in orbit (generally at 300 km). At this height it is released with a mechanical system (IRIS-ASE).

After it has moved a safe distance away, its own motor (IRIS-ISS) is activated and it accelerates to carry the payload into a different orbit. A typical application is that designed for an elliptical orbit having an apogee of 36,000 km (technically called the "transfer orbit") with respect to the geostationary orbit.

The Laben laboratories have produced five specific parts for the IRIS system. The first, important for control, is the usual OBDH [On Board Data Handling] system, that by communicating with the processor and the astronauts on board, carries out the final delicate controls in orbit, and manages the complete release operation from the opening of the sunshields to the release.

Another feature has been the active control electronics for nutation (ISS) which, by sending a series of synchronized commands to the special gas engines, corrects until it has annulled the eventual nutation of the axis of rotation of the ISS that is caused upon release from the shuttle.

No less important are another three technological systems:

- the timing sequencer, that while always taking care of the safety of the shuttle and of the crew, activates the pyrotechnic devices and, in particular, the ignition of the main ISS engine. Once this maneuver has been terminated it is able to control the separation of the satellite and finally, the parting from the spent ISS;
- the system for the acquisition and transmission to earth (via the shuttle) of data from the ISS, indispensable for a successful launch;
- the ISIR-COE (Check-Out Equipment) system used to support the integration of IRIS conducted by Alenia Spazio, Snia-Bpd, and in the pre-launch phase by NASA.

## **AUTOMOTIVE INDUSTRY**

### **Renault Unveils Amphibious Car**

93WS0324C Paris AFP SCIENCES in French  
25 Feb 93 p 41

[Article: "A New 4x4 Experimental Vehicle by Renault: The 'Racoon'"]

[Text] Paris—In March, at the Geneva Automobile Show, Renault, the French manufacturer, will present a new experimental vehicle—an amphibious 4x4 concept-car capable of all-weather operation over all terrains.

This vehicle, baptized the Racoon, was developed in 13 months, between November 1991 and December 1992, jointly with, in particular, Usinor-Sacilor, Ugine, Michelin, and Philips.

It combines characteristics borrowed from aviation (with a sort of glass bubble offering maximal visibility), from sports cars (with its three occupants almost in a reclining position), and from heavy-duty vehicles (with a power of 262 hp developed by a six-cylinder, 2,963 cubic centimeter, motor, supercharged by two turboblowers).

The "Racoon"—so-named after the English "raccoon," which is very fond of climbing, of water, and of "cleanliness"—can operate over any kind of terrain whatever, at a maximum speed of 155 km/hr, but it can also travel over water at a good speed (5 knots) by means of two internal propellers.

As Renault considers its return to the 4x4 market—it no longer distributes the Jeep trademark since 1 January—its engineers clearly wanted to enjoy themselves by combining time-tested solutions (such as the bi-turbo, which will shortly be seen on the Safrane model) with futuristic solutions (particularly, special steels).

The windshield wipers have been replaced by an ultrasonic device that disintegrates the water molecules as soon as they touch the surface of the windshield. The rear-view display—the video image sent by rear- and side-mounted cameras—obviously functions during motion in reverse gear. In forward motion, however, the rear-view system does not go into operation unless it detects, with its computer, the presence of a moving object in the process of gaining on or passing the vehicle.

### Renault To Unveil Amphibious Car

93WS0335B Paris *L'USINE NOUVELLE* in French  
25 Feb 93 p 38

[Text] Renault will present a new car design, christened Racoon, at the Geneva Automobile Show next month. The 4 X 4 amphibious vehicle was developed in partnership with Usinor Sacilor, Ugine, Michelin, and Philips. It is powered by a 262 hp engine, can travel any terrain at a maximum speed of 155 km/h, and can skim across water at 5 knots through the activation of two propellers. Engineers have also attempted to incorporate all the comfort features that have been devised over the last few years into the automobile.

### European Auto Factories Adopt Japanese Methods

93WS0335A Paris *L'USINE NOUVELLE* in French  
25 Feb 93 pp 26, 27

[Article by Alain-Gabriel Verdevoye: "European Manufacturers Copy Japanese Transplants"; first paragraph is *L'USINE NOUVELLE* introduction]

[Text] The Nissan plant in Sunderland, Great Britain, serves as a standard for new sites, which are designed

around logistical flows. Its workers are young, better educated, and fewer in number.

A brand new plant—clean, neat, spacious, and sitting like an architect's model on a carpet of green grass—is a common fantasy among European automakers. They dream of it as a counterpoint to the ultramodern factories the Japanese are opening up in Great Britain. For Volkswagen, the idea is no longer a castle in the air. Last Monday—with much fanfare—the group's president Ferdinand Piech inaugurated the industrial site of his Iberian subsidiary Seat in Martorell, near Barcelona. The King Juan Carlos of Spain was in attendance.

The solemnity of the occasion was entirely in keeping with the event. Indeed, the threat of excess capacities and the inexorable succession of layoff plans are making the opening of plants by Old World automakers especially rare.

Yet no fewer than eight new mechanical or assembly plants for Volkswagen, Mercedes Benz, General Motors, Fiat, or Peugeot cars will be springing up over the next three years, in a desperate attempt to reduce production costs that exceed those of the Japanese. Billions of dollars will be invested, in decisions that were made in the late, pre-recession eighties. Management would probably think twice today before freeing up 9 billion French francs [Fr] for Martorell, Fr7 billion for Rastatt (Mercedes-Benz), or Fr6 billion for Hordain (PSA-Fiat), now that Europe's industry is preparing to eliminate 40 percent of its jobs by the turn of the century.

Thanks to their somewhat bold prodigality, however, European manufacturers have a formidable tool for experimentation. "Martorell is a pilot factory. And the new ideas concerning logistics and the organization of work will later be applied to the entire group," proudly declares Peter Walzer, the vice-president of Seat, who is in charge of technique. Mercedes-Benz is just as enthusiastic. "The Rastatt plant (which was inaugurated last year) enables us to experiment with new methods. And if it is successful it will serve as a model for our older plants at Bremen and Sindelfingen," chimes in Wolfgang Ritter, Rastatt's director of human resources. The new factories are designed Japanese-style around logistical flows, versatile shop cells, in-house just-in-time standards, and better routing of components to the assembly lines. The personnel is young and specially trained. Everyone is haunted by the Nissan model in Sunderland, Great Britain. The fact is, it is easier to practice in vitro fertilization of new organizational concepts in virgin territory! Renault's former president Raymond Levy claimed that if he could build a Flins Number 2 on the other side of the Seine from scratch he could easily match the productivity standards of Japanese automakers in Europe. Renault's boss did not have the means. But his competitors' experiments seem to be proving him right.

The first element in competitiveness is age and its corollary—workers' level of education. The average age

of the 3,500 workers already employed at Martorell is barely 30 years, against 28 at Nissan in Sunderland, but 53 at Seat's old Zona Franca site in Barcelona. It will be 30 years as well at the future French Hordain site when the plant begins production of single-seater vehicles in January, 1994, compared to 40 at the particularly "young" Poissy plant. There are no illiterates in the new factories: Workers need at least a CAP (certificate of primary studies) or a BEP (vocational studies certificate) to apply at Hordain, plus 1,000 hours of training. Applicants must also pass behavioral and group-work aptitude tests, as they do in Eisenbach (former DRG), the latest of General Motors's assembly plants.

The second factor leading to increased productivity is a new way of organizing work, one that is made possible by the youth and qualifications of both the workers and management. But also, stresses David Herman, CEO of Opel (General Motors), by the "lack of industrial tradition" in the new sites. "Work in teams of 12 people, who are much more autonomous and take on much greater responsibility than in the group's other factories, is a priority. Moreover, we will be cutting out two layers of hierarchy," say Hordain officials.

At Rastatt, operators no longer work alone at the same stations; in teams of four to six, they divide up the work necessary to assemble complete functions. Each one calls directly for the parts he needs, assumes responsibility for maintaining—and even repairing—his tools, and controls his own quality. And it is up to the worker responsible for any faulty work to repair his own mistakes. As a result, the number of assembly inspectors is only half that in Sindelfingen. These practices on which Mercedes-Benz prides itself have already been implemented—very partially—by other European automakers. But the firm with the star logo has been able to systematically organize them into a coherent whole. "Japanese" work methods are also cropping up among automobile equipment suppliers such as Valco in its new Meung-sur-Loire site in Loiret and Gorseinon site in Wales. An important indication of good productivity is low absenteeism: At Eisenbach, the rate is barely 1 percent, while it fluctuates around 10 percent at Russelsheim, an old Opel plant dating from 1929.

A third essential step in tackling higher costs is stock reduction. Martorell has halved its materials stock by optimizing its flows. On the assembly line, each operator has enough parts for barely one hour of work, compared to five days at Zona Franca. Martorell does have three times as many just-in-time suppliers delivering to it.

#### An Excellent Theoretical Background

The upshot of this cultural revolution is that it takes three to four hours less to assemble an intermediate class Mercedes in Rastatt than in Sindelfingen. Each employee may be able to assemble 50 to 60 cars a year by mid-decade in Martorell, against an average of 25 in Zona Franca. The two plants do have somewhat different integration rates. The Martorell flexible factory

should also prove less sensitive to the ups and down of the economy, thanks to a breakeven point at around 60 percent of capacity. Volkswagen's German plants are only cost-effective when the lines are virtually saturated!

All the experts agree that Europeans now have a theoretical background in organizational methodology comparable to that of the Japanese. But handicapped by the weight of their "cultural traditions" and by their relatively limited equity, they are fighting with their backs to the wall. The new, remarkably designed plants at Martorell, Rastatt, or Eisenach are meant to illustrate European know-how. Now all that needs to be done is to spread this knowledge throughout the industrial fabric. Time is running out.

Toyota and Honda followed Nissan's lead a few months ago by starting up production in Great Britain in plants the companies designed from scratch. And the installed capacities of the three Japanese firms on the other side of the Channel already exceed 500,000 cars. As it happens, these automobiles will have free entry into the Community, since the agreement Brussels and Tokyo hammered out on managed access of Japanese cars to the European market does not affect them.

#### Renault, Peugeot Study Microwave Techniques 93WS0337D Paris COMPOSITES ET NOUVEAUX MATERIAUX in French 22 Feb 93 p 6

[Text] Collaboration between several CNRS (National Center for Scientific Research), Electricity of France, Peugeot, and Renault teams has produced an entirely innovative use of a heating source well known to cooks: microwaves. The researcher and manufacturer teams studied all the characteristics of microwave heating in a program dubbed "Fabrication and Mechanical Characterization of Organic-Matrix Composite Materials Using Microwaves." Their goal was to use the heating technique to fabricate polymer or composite materials. The agriculture-food industry has employed microwave technology since the fifties. Now that scientists have mastered these electromagnetic waves and an applicator for oversized microwaves has been developed, the technology is expected to crop up in new industries (automobile, aeronautics, or railway). Andre-Jean Berteaud directed work to devise the applicators, which were patented by the CNRS in 1982. His conclusions stressed the importance of preserving the simplest wave-propagation structure, by placing the treated material in just the right relation to that structure.

The second phase of the teams' research dealt with the treatment of polymer materials and assessed the variations in their dielectric parameters. The main sticking point in the technology lies in the dimensioning of the materials. Microwaves penetrate materials differently depending on their size and shape, and form hot and cold points in the object being treated. Hence the need to devise procedures that take into account the size of the object and the length of the radiation wave used. "That is why we choose the propagation mode and perhaps the

radiation frequency as a function of the material, to avoid non-uniformities in treatment," explains Michel Delmotte, a researcher at the CNRS Thiais "Molecular and Macromolecular Organization" laboratory.

Mechanical pressure is another constraint. The latter is a delicate and vital step in the elaboration of composite materials, whose mechanical performance often depends on whether the cohesion between matrix and reinforcing pieces is good or bad. To skirt this difficulty, the material and its mold must be contained in an applicator that is completely full so that mechanical efforts can be transmitted. They must be positioned so that the simplest propagation structure is maintained, so that the mold and material do not become the locus of a train of standing waves set off by their interfaces, and so that most of the electrical energy carried by the waves is effectively dissipated in the material.

Another field of investigation is the effect of microwaves on chemical kinetics. Results have shown that the degree of advancement of the epoxy resin and amine functions is identical—as is their macromolecular network—when the pattern of their heat changes is the same.

Though this technique is of value for materials that are poor heat or electricity conductors, it is proving especially worthwhile for structural composites. The microwave procedure cuts the reaction time of materials transformation at least in half, while promoting difficult reactions.

Contact: Michel Delmotte, Thiais CNRS, Phone: 49 78 11 51.

#### German Institute Develops Optical Exhaust Gas Analyzer

93M10432 Munich SUEDDEUTSCHE ZEITUNG  
in German 11 Mar 93 p 33

[Text] Physicists in Freiburg have developed an optical process capable of determining the composition of car exhaust fumes, even during starting and changing gears. Previously, measurements of this type had only been possible at constant engine speeds. The Fraunhofer Society has announced that Maurus Tacke and his colleagues at the Fraunhofer Institute of Physical Metrology use a semiconductor laser that measures the exhaust fume components in a matter of milliseconds. The researchers exploit the fact that gases absorb light of characteristic wavelengths. For example, if the new method reveals rapidly fluctuating gas concentrations, they can look at the combustion process in the individual cylinders. Information of this type is of considerable importance to designers of fuel-saving, environment-friendly engines. By installing measuring probes at both ends of a catalytic converter, the Freiburg team can find out directly to what extent the converter reduces polluting gases such as nitric oxide or carbon monoxide. However, the researchers say that the sophisticated technology makes the process too expensive for routine measurements.

## BIOTECHNOLOGY

#### France: Host-Vector Project Produces Patent Applications

BR1604121693 Paris BIOFUTUR in French  
Mar 93 pp 53-56

[Article by Annick de Chenay: "The High-Performance Host-Vector Couples Program: Five Years of Activity"]

[Text] Five years after the start-up of the High-Performance Host-Vector Couple program (CHVP), launched in 1986 by Organibio (Interprofessional Bioindustry Organization) and the public authorities, the results are positive. The program, which involves industrial companies and researchers, has developed valuable genetic recombination tools for industry and brought together two separate worlds kept apart for too long.

Representatives from Organibio, the Space and Research Ministry (MRE), public laboratories, and the industrial companies concerned met in Paris in early November 1992 to assess the results of the cooperative and multidiscipline research program on high-performance host-vector couples.

#### CHVP Program

In 1986, with the public authorities and Organibio behind them, seven industrial companies involved in biotechnology (CNTS [National Center for Blood Transfusion], the Merieux Institute, the Cayla laboratory, Orsan, Rhone-Poulenc Sante, Roquette Freres, and Roussel-Uclaf) decided to join forces and cofinance a research program, on a 50-50 basis, along with the Space and Research Ministry. The program involves a dozen or so public laboratories and has been allocated an annual budget of 6 million French Francs [Fr] over a five-year period. The industrial financing, which went mainly toward paying the researchers, was run by Organibio.

Aware of the industrial potential of the biotechnology research planned, the program participants fixed the objective of developing some performing expression systems for heterologous proteins. This was a branch of research of great interest to the participants as a whole in both its fundamental (essential for public laboratories) and applied aspects.

Since the first industrial applications of in vitro genetic recombination had already been achieved, researchers chose host organisms they knew well, such as *E. coli*, even though these microorganisms were of little interest to industrial companies. Biomanufacturers, therefore, found it necessary to persuade researchers to use host microorganisms better adapted to industrial production. This implied discovering and developing corresponding vectors. The program title summarizes these different objectives.

In order to set up the program, manufacturers and researchers pooled their respective expectations and capabilities in order to select the best adapted hosts. The ideal

host, suited to both manufacturers' and researchers' needs, did not exist. It therefore was decided to use a number of different hosts ranging from those most adapted to the needs of researchers to those suited for manufacturers, such as the corynebacteria, for which no vector was known. In the end, the project retained yeasts (*Bacillus subtilis*, *Streptomyces*), corynebacteria, and animal cells for proteins requiring post-translational modifications. The program thus was divided into five main topics.

Naturally, the manufacturers had varied levels of interest in the chosen topics. To improve cooperation, they decided to pool their previous knowledge and know-how and equally share the program funding as well as the results. This decision greatly simplified the setting-up of the program and introduced a high level of flexibility which contributed to its successful management by Organibio. This turned out to be a very wise decision given the rapid evolution in scientific developments during the course of the program and the changing interests of the industrial companies over time.

It was decided that the program results would belong to the laboratory having obtained them and that the industrial contractors would have preferential access to operating licenses upon payment of a fee. Each industrial company has the right to adapt any expression systems developed within the program to its own specific protein production.

Each topic was led by a working group directed by an industrial partner assisted by a scientific counselor, and laboratory directors working in the field (see table). After some misgivings, the industrial leadership of the program was accepted fully by the researchers involved and proved to be well adapted to the objectives fixed. A scientific committee uniting all the sector groups and organized by Organibio coordinated the work undertaken and made the necessary decisions at each stage: budget management, changing research topics, stepping up promising projects and abandoning less promising ones, filing patent applications, issuing publications, etc. Each year, a private scientific symposium reunited the contractors and researchers in order to present the scientific and technical results obtained.

**List of Participants**

Laboratories		Directors
<b>Topic: <i>Bacillus subtilis</i></b>		
<b>Pasteur Institute; CNRS<sup>1</sup></b>		
Pasteur Institute; CNRS <sup>1</sup>	Mr. Rapoport <sup>6</sup>	Mr. Renaud (Orsan)
INRA <sup>2</sup> Jouy-en-Josas	Mr. Ehrlich	
INA <sup>3</sup> ; PG-CNRS	Mr. Steinmetz	
<b>Topic: Corynebacteria</b>		
CNRS-Marseille	Mr. Patte <sup>6</sup>	Mr. Marcel (Roquette)
CNRS-Toulouse	Mr. Sicard	
INSA <sup>4</sup> -Lyon (and Rennes University)	Mr. Planco	
Pharmacology Faculty, Marseille	Mr. Dumesnil	
Paris-XI; CNRS	Mr. Leblon	
<b>Topic: Yeasts</b>		
CNRS; Bordeaux-II University	Mr. Aigle <sup>6</sup>	Mr. Fleer (Rhone-Poulenc)
Pasteur Institute; CNRS	Mr. Davies	
<b>Topic: <i>Streptomyces</i></b>		
Paris South-XI; CNRS	Mr. Guerineau <sup>6</sup>	Mr. Sabatier (Rhone-Poulenc)
Pasteur Institute; CNRS	Mr. Davies, Mr. Thompson	
CAYLA Laboratories	Mr. Drocourt	
<b>Topic: Animal Cells</b>		
Virology Institute, Strasbourg	Mr. Drillien <sup>6</sup>	Mr. Lamy (Merieux Institute)
Gustave-Roussy Institute, Villejuif	Mr. Fradelizi	
INTS <sup>5</sup> , Paris	Mr. Cartron	
INRA, St.Christol	Mr. Bergoin	
(1) CNRS: National Center for Scientific Research		
(2) INRA: National Institute for Agronomic Research		
(3) INA: National Agronomics Institute		
(4) INSA: National Institute for Applied Sciences		
(5) INTS		
(6) scientific adviser on the subject		

**Bacillus subtilis**

Because the genetics of *Bacillus subtilis* were well known, the laboratories concentrated their work on the development of replicative expression vectors combining a control system (inducible promoter belonging to the sac B gene coding for a saccharase levan) and an amplification system (at the origin of bacterial replication). These developments, tested by means of a model protein, a cellulase, produced satisfying results at the laboratory and preindustrial levels. In a 20-liter fermentation reactor, 30 units/ml of cellulase were produced equivalent to 250 mg of protein per liter. This work resulted in the filing of a patent.

**Corynebacteria**

Significant progress in our basic understanding of corynebacteria allowed for the application of genetic engineering techniques to these bacteria. Progress still needs to be made, however, in the levels of expression. A technique for transferring genetic information by electroporation was developed, as well as *E. coli*-corynebacteria shuttle vectors and vectors allowing the isolation of promoters with the help of reporter genes. Two insertion elements were used in the construction of integrative expression cassettes. A patent was filed.

**Saccharomyces**

With the *Saccharomyces cerevisiae* yeast, a microorganism already well known to manufacturers and researchers, major advances were made in the development of a compatible-transformant selection system meeting the biological and financial demands of the industrial companies. This system, which led to the filing of a patent, is based on a dominant selection marker which makes [the cell] resistant to cyclohexamide, an antibiotic acting only on eucaryotic cells. There are a number of potential applications, including sensitive yeasts and insect, plant, and mammal cells.

**Streptomyces**

The work in the field of *Streptomyces* has definite industrial potential. Despite the fact that, to date, no biologically interesting proteins have been satisfactorily produced, a number of tools have been developed. These include expression vectors (integrative vectors with a large host spectrum), promoters (the development of promoters from the heat stock system of *Streptomyces*), and strains complying to both researcher and industrial criteria (selection criteria linked to the production of heterologous proteins). In the end, two strains were retained. Their potential as host cells was demonstrated with the aid of two model proteins. The results obtained with a heterologous protein (one coded for by the nef gene of HIV) repeatedly have revealed production rates corresponding to 0.5 percent of total proteins. According to company directors, these results are sufficient to be considered within the framework of an industrial strategy and various applications already are being

envisioned (the production of enzymes and antibiotics). Two patents have been filed on this topic.

**Animal Cells**

Two different approaches were developed leading to the filing of two patents.

The first method involved cells with a high secretion capacity that can propagate in suspension (immortalized cells from the B-lymphocyte strain). The project used existing expression vectors based on an adenovirus sequence (major delayed-action promoter, viral sequences stimulating translation) to which it added new elements (Ori-P and EBNA1 sequences from the Epstein-Barr virus, a mitochondrial DNA sequence of murine origin, a promoter and activating sequence of immunoglobulin genes). Various combinations of these elements were tested to optimize the characteristics of both the integrative and replicative vectors. The synthesis and secretion of a model protein, erythropoietin, was studied for the most powerful vector using a 100-liter fermenting reactor and produced satisfactory expression levels.

As for the second method, it consisted of an original approach investigating the capacity of an insect densovirus (Junonia) to serve as a vector. (A densovirus is a pathogenic DNA virus of the parvovirus family which infects insects.) The functionality of Junonia-lepidoptera cell couples was demonstrated. The development of recombinant defective viral genomes enabled researchers to obtain transformed cell lines in which the viral genome remains stable in the episomal or integrated form while expressing a foreign gene. These results offer interesting perspectives for biological developments.

**Example of Successful Cooperation**

Launched on the basis of an original initiative, the CHVP program has demonstrated widely its capacity to bring together and organize cooperation between public research organizations and industrial companies. It established a synergy between laboratories which did not know each other before. Industrial companies worked together and significant advances were made in fundamental research on topics such as the corynebacteria. The arrival of new researchers in the laboratories efficiently contributed to meeting the new objectives. The program partners all recognize the benefits that can be achieved from a collaboration between teams with different perspectives. Not all the objectives were met. It quickly was apparent that the models studied did not always permit full-scale production of heterologous proteins. In the case of yeasts and animal cells, the program was not able to bring together a sufficient number of laboratories. Despite this, extremely useful genetic recombination tools were developed which will allow industrial companies to make sound judgments and to pursue their own research. The filing of seven patents (of which some extended abroad) and the publication of

numerous articles demonstrate the scientific and technical interest in the results obtained. Publication of the results, of crucial importance to the public laboratories and especially to young researchers, was not delayed by manufacturers, which rapidly approved their release. The CHVP program also gave industrial companies a rapid access to specific know-how. It succeeded in bringing together two worlds (research and industry) which were separated from one another for too long. The external demand for tools developed under the program and the continued cooperation between industrial companies beyond the CHVP program also demonstrates its value. Finally, the biotechnology sector has demonstrated that it is a stimulating area for research and a means of training young researchers, many of whom found employment during the course of the program.

One problem that should be taken into account in such future programs is the time element. It took almost three years to set up the program, which implied a thorough evaluation of the projects involved. The program had been planned over a five-year period, which appears to be a minimum taking into account the more or less lengthy start-up period. Although the industrial companies were prepared to make a five-year commitment, it was impossible to obtain the same agreement from the public authorities. It took three attempts before the project was launched finally. This gives us an idea of the confidence that has been established between the different partners and the public authorities. The necessary continuity in the research imposes administrative procedures that take account of this.

## COMPUTERS

### Germany: Fiber Distributed Data Interface Networks High-Speed Computers

93WS0363A Duesseldorf VDI NACHRICHTEN  
in German 19 Feb 93 P 19

[Article by Konrad Buck: "Hamburg Supercomputers No Longer Singletons"]

[Text] VDI-N, Duesseldorf, 19 Feb 93—Research institutes require high-speed networks. For years good interfaces have been eagerly awaited among Hamburg computer centers. After drawn-out preliminary negotiations the start signal has now been given for the Hamburg high-speed computer network [HHR].

The outcome is an optical communications network that is readily visible: it comprises three loops of nearly 158 km of fiber-optic cable using Fiber Distributed Data Interface [FDDI] technology on which it is possible for a half dozen scientific establishments with an approximate total of 3,900 computers to intercommunicate. Not counting Hamburg University, the parties include the Harburg Institute of Technology [TU], the War College, the German Electron-Synchrotron [DESY], the German Computerized Weather Center and the Company for the Use of Nuclear Power in Shipbuilding and Navigation

[GKSS] in Geesthacht. While FDDI still does not signify unrestricted express traffic for all users, the new solution does entail a distinct improvement in data throughput. This enables optimum utilization of the mainframe high-performance computers of all the scientific establishments dotting the Hamburg landscape.

Despite the present approximately 20 percent initial useful capacity of FDDI and in view of the anticipated high occupancy of the network, Hans-Joachim Mueck, HHR coordinator and director of the Hamburg University data processing computer center, remains unperturbed. The reason for this is: "Right from the start of the HHR there will be interfaces between users and vector computers (two Cray, three Convex, one SNI S100/1). Up until now that has only been wishful thinking." Until now it has been possible for users to access the supercomputers from a workstation only via a local Ethernet network having 80 percent usable capacity, so at best an Ethernet network with at most 8 Mbit/s. "At the latest the network simply shut down after the fifth subscriber logged on."

In contrast there are now massive facilities for high-speed data communications. Muck goes on to state: "There is simply nothing otherwise comparable to what we have here. On the existing scientific network [WIN] the speediest connections between two institutions are 64 kbit/s, and the 2 Mbit/s ones via the HDN are just now coming on line. A higher-speed network simply had to emerge. And that is just what we now have here. Granted, it is no quantum leap, but it is a significant step forward."

[Begin boxed item]

### FDDI Networks

FDDI [Fiber Distributed Data Interface] represents high-speed data transmission via fiber-optic cable between computers and terminals. Typical transmission speeds are quoted at 100 Mbit/s. While FDDI networks are also mentioned in connection with local area networks [LAN], their range of applicability extends far beyond conventional LANs. Spanning a length of up to 100 km, it is possible for as many as 500 workstations to be hooked up, including FDDI networks for pure data transmission as well as so-called multi-service networks. The latter, also designated FDDI 2, could transmit voice as well as data services.

[End boxed item]

Graphic representation of computerized data uses large communication bandwidths. Scientists no longer want to view these in tabular form or as numerical sequences, but as much as possible as animated graphics. The computerized data from a supercomputer therefore are transmitted directly to a video workstation. Furthermore, they want to change parameters and want to be able, as quickly as possible, to see how that affects the model.

According to Gerrit Henken who is in charge of communications at the Computerized Weather Center, "One

weather image consists of approximately 10 Mbyte. A brief sequence of 10 images therefore is now a reasonable quantity of data." For purposes of illustration the scientist even alludes to the Bible: "The entire text of the Bible comprises about 5 Mbyte of characters. Computerized data are now either outputted from color printers or viewed on a workstation, if at all possible, as a series of images."

It is extremely fatiguing to view such series of images at conventional data rates of 64Kbit/s. It takes about two to four minutes for 1 Mbyte to be transmitted. This means that it can take half an hour for an entire image to be assembled. In the FDDI loop in contrast, 1 Mbyte needs less than one second and an image is transmitted in about 10 seconds. The result, according to Henken, is the possibility at least of sequences at the "tempo of a flip-book."

Aside from the four Convex and SNI mini-supercomputers, the two Cray supercomputers at the Computerized Weather Center are the only "number crunchers" in the Hamburg area. It is Mueck's observation that "the earth scientists, for instance, who collaborate intensively with the Computerized Weather Center personnel, are waiting with baited breath to be able to use the fiber-optic. They would like at last to transport their data back and forth between their workstations and the vector computers in a rational manner."

In Mueck's opinion the 1 Gbit/s high-speed Ultranet would not be the technology for developing high speeds on long-distance service networks such as the HHR. It is a proprietary system with expensive components to match. ATM [asynchronous time multiplexing] for him is the transmission process for future digital broadband networks [B-ISDN], with potential speeds of 600 to 800Mbit/s being the next stage. Highly intensive research is being done on this at the Berkom in Berlin. The postal service is also endeavoring to push development in this direction. ATM, however, is presently just in the first generation, that is, the definition phase. Mueck believes that it will take another three to four years before ATM can be brought into production. The sort of E-mail and conference-switching activities that occur in everyday scientific work constituted an immense load for the old data networks. Until the inception of HHR, each staffer retrieved his information from mailboxes, service databanks or directly from the computers of friendly colleagues. Mueck goes on to say, "The first thing we will offer on the new network is an info-server buffering all the services and information from outside and that everyone on the network will have access to. Individual electronic mail completely overloaded the nation's networks, cost an awful lot of money and adversely impacted the work of others."

Initially, industrial users will not be allowed on the network. They can, however, join as partners in cooperative projects with institutes on data aggregates. The universities are being asked to open themselves more to science and engage in less ivory-tower research and instead in more cooperative projects.

Network management has been handed over to the Hamburg University data processing department. As Mueck says: "It is our job to discover and eliminate any chokepoints and problems on the network. Naturally, using specific routing information, interlocks, etc., we will also have to see to it that computer time on the supercomputers is appropriately allocated."

#### **Fraunhofer Society Establishes Virtual Reality Demonstration Center**

*93WS0365D Duesseldorf VDI NACHRICHTEN  
in German 12 Mar 93 p 28*

[Article by Wolfgang Mueller: "Artificial Worlds Simplify Robot Control"]

[Text] VDI-N, Duesseldorf, 12 Mar 93—The Fraunhofer Society is the first institution in the world that has established a demonstration center for virtual reality [VR] applications. A number of institutes in Stuttgart and Darmstadt are associated with it. It enables mostly small and medium-sized firms to use the expensive hardware and software for the creation of artificial computer worlds.

There is hardly any hint of "cyberspace" fantasies and utopian dreamworlds on the third floor of the "home of graphical data processing" in downtown Darmstadt. Dr. Martin Goebel, spokesman for the virtual reality working group at the Fraunhofer Institute for Graphical Data Processing [IGD] in Darmstadt emphasizes, "we are technicians and simply wish to acquaint interested firms with this newfangled human-machine interface." This is why his research institute and the Stuttgart Fraunhofer Institute for Industrial Economy and Organization [IAO] and for Structural Physics [IBP] have set up a decentralized system for "virtual reality" demonstration and competence. Each institute disposes of the space, know-how and necessary hardware and software to provide companies and scientists with the necessary infrastructure for test, presentation and development tasks. The package also includes counseling, training and prototype development.

"It is now possible for us to get back on the monitor and jump off into space," is how Oliver Riedel, manager of the demonstration and competence center for virtual reality applications at the Stuttgart IAO, describes the journey into the artificial world. VR is far from being a game any longer. Currently in the U.S. and in Japan, robots are now being controlled, aircraft simulated and medications designed on the video screen with the aid of that display technology. Urban planners and architects are also now using artificial reality. So are office furnishing manufacturers, physicians and instructors.

At the first VR conference in German-speaking territory, held in Stuttgart in February and called "Virtual Reality '93—Applications and Trends," Institute for Production Engineering and Automation [IPA] manager, Prof. Hans-Juergen Warnecke, and others, presented a "virtual reality workstation" developed at his institute. The images produced by the powerful graphics computers were directly

controlled by the head motions of the operator ("tracking") and transmitted to the two flat video screens in his goggles so that he could stereoscopically perceive and comprehend the simulated world. The operator maneuvers about in the virtual world using a six-dimensional [6D] control ball without having to leave his real world position on a chair. His hand movements are directly translated via a data glove into target-path data for a virtual robot. An interface then relays the data to the real industrial robot that precisely executes the hand movements of the operator. Professor Warnecke emphasizes that "this enables any complicated paths to be generated in real time with all six degrees of freedom." Conventional teaching panels and costly path programming of the robot are dispensed with.

Markus Rode also promises "risk-free investments." At the official inauguration of the Darmstadt VR demonstration center in late February, the sales manager with Wilkhahn in Bad Muender, a manufacturer of office furnishings, presented applications from the interior design sector, that had been developed by Darmstadt scientists under commission with the company. Wilkhahn has already used the new presentation technology, for example, to design the interior decoration and furnishing of the new airport in Abu Dhabi, in the furnishing of a company canteen and in planning the interior furnishings for a bank.

A routine CAD program supplies the data needed for the three-dimensional visualization, but they still have to undergo "rendering" and "ray-tracing."

Although at present the main uses for VR are in the areas of architecture and interior design, Dr. Martin Goebel alludes to a usefulness for this new technology that is independent of any given sector. The VR expert encourages all potential users by saying, "we are able to use data from any 3D-CAD program and then interactively manipulate, view or exploit the model." Users need only bring their data into one of the demonstration centers. After preliminary processing in the powerful graphics computers—in Darmstadt the hardware inventory alone costs nearly DM500,000—there is nothing left to block a flight into the simulated world. Even light and motion simulations (e.g., of machine parts) are possible.

Costs depend on the extravagance and pilot nature of the commission. "Our hourly charge varies between DM100-150," reveals Dr. Goebel, whose institute, like all the Fraunhofer Society Institutes, has to finance itself largely out of commissions from the private sector.

#### Germany: Downward Trend in Computer Development Foreseen

93WS0377A Berlin INGENIEUR DIGEST in German  
Jan 93 p 58

[Unattributed article: "Crisis at the Computer"]

[Text] As recently as 18 months ago many companies regarded the future with optimism. They bought new hardware and updated their software. A survey shows

that as a result of restructuring, privatization and market adjustment, dramatic changes have in part occurred in the companies' data processing. The trend: downward.

There is bad news for data processing workers in Saxony: The number of employees is being heavily cut back. Many companies have not achieved the sales figure targets for 1992. The hardware and software environments have often been designed too large for the present size of the enterprises. Development divisions are being permanently cut back. A growing number of companies can no longer cope with the costs of their own data processing.

Thus far, to begin with, the main trends of the preliminary analysis of a study which was made available to INGENIEUR DIGEST by the Berlin market research company Koehler-Frost & Partner. The analysts asked managers at 80 major Saxon companies. The survey will be presented in Freiberg on 20 January. (Preregistration for the event, see below.)

For those who are particularly interested: Which alternatives do the managers envision? Does downsizing the data processing areas or outsourcing them offer a solution, or do data processors perhaps even see their chances in joint computer centers?

What is certain is that in many enterprises the core of the data processing divisions is now at stake; 33 of 80 companies indicate that in 1992, just as for their employee figures in general, they cut back their data processing employees as well by more than 30 percent over the year before. At the turn of the year another 15 percent of the jobs were eliminated. The job cuts are so serious that by now one out of five companies is thinking about outsourcing. Many will scarcely have any other alternative.

It is primarily by way of reducing personnel costs that the Saxons, as well as managers in the other new Laender, are trying to make their companies competitive. In parallel, they are also slashing the data processing budgets. Practical arguments in favor of information processing, for example the up-to-date knowledge about production, purchasing and operation or the possibilities of reacting rapidly to altered market requirements, are taking a back seat to the need to save.

In fact, a growing number of managers now seems to regret their decision about buying sophisticated hardware in the euphoria of the turnaround. If the number of experts employed continues to drop, the companies will hardly be able to install and adapt the necessary software any longer.

Even now, the data processing costs are disproportionately high in many companies. They often amount to twice the normal figures for western German competitors, market analysts reported. In view of the necessity of reducing costs, there is hardly any way out of this predicament for the managers other than further layoffs, because contracts for standard software and hardware were usually agreed on for the medium term and are difficult to change.

Thus, even companies which until now had been thinking of outsourcing may in the future hardly have any choice but to shift their data processing service outside. However, this is only possible on the condition that suppliers lower their often still overpriced costs.

In fact, the modest sales results of the major hardware suppliers in eastern Germany confirm the trend in the survey. Although the salesmen, whether at Siemens Nixdorf or Hewlett Packard, IBM or Apple, continue to be optimistic, hardly anyone reaches the targets announced for eastern Germany.

Trust Agency companies are not able to afford costly investments, the financially weak eastern German medium-sized businesses are rather more restrained with new purchases and investors usually bring their data processing along. Except for public institutions, very few major deals can be made, and the stagnating economy further dampens expectations.

Even so, the Koehler-Frost analysts discovered a glimmer of hope: The Saxon companies interviewed anticipate an average increase in sales in 1993 of 22 percent, compared to 1992. This does not mean that data processing is out of the woods, by any means. It will take at least three to four years, market researchers fear, before conditions return to normal in the data processing sector.

#### [Boxed information]

The First Convention of Saxon Data Processors Freiberg in Saxony, Innovation Center 20 January 1993. The conversation between manufacturers and suppliers will be moderated by Thomas J. Bencard, INGENIEUR DIGEST, and Dieter Eckbauer, COMPUTERWOCHE Inquiries: Koehler-Frost & Partner Christiana Schute Ruedesheimer Platz 8 W-1000 Berlin 33 Tel: 030/821 30 73 Fax: 030/821 03 52

#### Switzerland: Funds Provided for Computer Science Research

93MI0400 Eschborn NACHRICHTEN FUER AUSSENHANDEL in German 18 Feb 93

[Text] Switzerland is paving the way for new developments and applications in computer science. The first step in this direction, taken at the end of 1992, was the Swiss National Fund's approval of financing for the series of projects making up the Computer Science Priority Program (SPP IF). The Swiss Confederation is primarily using these research projects to further the theoretical basis of computer science applications. The program, which will run until 1995, covers three areas (modules): secure complex systems, knowledge-based systems, and massively parallel systems.

A total of 157 projects that would have cost a total of 80 million Swiss francs [SFr] have been submitted in response to a call for bids. Savings measures adopted by the federal government, however, mean that only around SFr25 million will now be available to the end of 1995.

By far the largest number of bids, 74, were submitted under Module 2, knowledge-based systems. Of these, 12, costing around SFr3.8 million, were approved for 1992. On average, the most costly projects were those submitted for Module 3, massively parallel systems, under which 13 projects were accepted for an approximate total of SFr3.7 million.

Module 1 aims to investigate the causes of deficiencies in existing information systems, and to submit proposals for improvement. Module 2 is intended to develop new potential in artificial intelligence for using computers to support managerial decision-making. It is divided into the following sections: logic, computer vision, multi-agent systems, computer-assisted linguistics, qualitative inference [Schliessen], and modeling. The research program for Module 3 covers software for parallel computers, special architectures, and new computing principles.

Switzerland has one of the highest computer ownership rates in the world (in 1991, 41 percent of all firms were using computers), and one of the highest rates of systematic usage of this technology. However, computer science research funding is low compared with companies' investment in other areas. A Conference of Swiss Universities (CICUS) initiative produced funding for pure computer science at Swiss universities between 1986 and 1991, a total of SFr177 million being spent on setting up and equipping training centers.

The contact address for the program management is: Swiss National Fund Priority Program Secretariat, Wildhainweg 20, CH-3001 Bern; tel. 0041131/272222; fax 0041131/233009.

#### UK: Manchester Computing Center Acquires Fujitsu VPX Supercomputer

93WS0409F Edam SUPERCOMPUTER EUROPEAN WATCH in English Mar 92 p 7

[Text] A Fujitsu VPX is soon to be supplied to the Manchester Computing Centre (MCC) of the university of the same name. The new system, a Fujitsu VPX240/10, has a configuration of 1 scalar processor, 1 vector processor with a peak performance of 2.5 GFlop/s, 1 Gbyte of main memory (MSU), and 1 Gbyte of secondary memory (SSU).

The purchase was approved at the end of 1992 following a procurement exercise earlier in the year by the Science and Engineering Research Council (SERC) for installation at MCC. It will replace the Amdahl VP1200 which will have been in service for five years. Delivery of the new machine is expected in July 1993 with an aim to complete installation and acceptance in time for a service start at the beginning of September 1993. The Amdahl VP1200 is expected to be removed at the start of December 1993. The staff at MCC is still very satisfied with the Amdahl, it has been an extremely reliable machine. The major problem with it was the availability of up-to-date software, following on from Amdahl's announcement that they were no longer going to market

the machine. The Fujitsu VPX240/10 architecture is similar to that of the Amdahl VP1200, but has 32 times more memory, and is over four times faster. The increased speed comes from an increase in both the number of arithmetic pipelines, and from an increase in the clock speed to 3.2 ns.

Rick Collins, assistant Director National Service at MCC, said that "the principal reason to select this machine was based upon scientific requirements which have been identified by SERC for a machine which would perform well in codes with very long vectors or required very large memory. The new supercomputer continues the programme of investment in national high performance computing facilities, overseen by the Advisory Board for the Research Councils and managed by SERC." In the UK there are three national supercomputer centres (Rutherford Appleton Labs with a Cray Y-MP and ULCC with a C3), and this purchase complements those other facilities.

#### **Europe's First nCube 2S System Installed in Germany**

*93WS0412H Edam SUPERCOMPUTER EUROPEAN WATCH in English Feb 93 p 13*

[Text] The Laboratory of Technomathematics at the University of Kaiserslautern, Germany, has installed an nCube 2S, a 72-processor nCube 2S Model 10, with 576 Mbyte of memory. This is the first installation of the new nCube 2S system in Europe.

Prof. Dr. H. Neunzert, head of the group in Kaiserslautern, stated that the nCube 2S system will be mainly used to solve computer-intensive numerical problems in different areas. One of the main applications is a fluid dynamics code for rarefied gases, which was developed in Kaiserslautern and is already parallelized. FE methods, fatigue analysis and image processing are further areas, in which the group will use the nCube. Prof. Neunzert expects that the nCube 2S system will be a powerful tool for a mathematician to study numerical research problems as well as to solve real world problems.

#### **Germany: Juelich Research Center To Install Cray Y-MP System**

*93WS0412I Edam SUPERCOMPUTER EUROPEAN WATCH in English Feb 93 p 13*

[Text] Forschungszentrum Juelich GmbH, also known as KFA, the largest of 16 national research establishments in Germany, has ordered a Cray Y-MP M94 system. This is the first order in the world for a four-processor, 2,048 Mbyte system from Cray Research's large-memory M90 series. The machine is expected to be installed in April, maybe even March (Cray is keen to install as soon as possible) and will replace the centre's existing Cray X-MP system. No real alternatives with different machine types were considered; it was not an open bid.

The new machine will be leased, just as the old one, but KFA is paying less. This is meaningful, because due to the financial situation in Germany, budgets for central data processing are reduced. The KFA spends about ECU15 million per year on leasing and maintenance and is trying to save ECU5 million for the next three years.

"The Cray X-MP has served us well," said Friedel Hobfeld, director of the Central Institute for Applied Mathematics, which operates KFA's supercomputing facilities. "The new Cray Y-MP will give us considerably increased processing power and about 16 times as much memory, allowing our researchers to work on more complex applications and problems than in the past. Although a variety of massively parallel systems show up on the market, we believe that in the near future vector supercomputers, like the Cray systems, will still serve as the primary workhorses for computational science."

#### **Netherlands Company Develops Three-Dimensional Printer**

*93BR0422 Rijswijk POLYTECHNISCH WEEKBLAD in Dutch 19 Feb 93 p 1*

[Article by Walter van Hulst: "Desktop Holoprinter on the Market by Next Year; Superfast Three-Dimensional Images of Medical Nuclear Magnetic Resonance Scans, Molecular Structures, or Current Flow Patterns"]

[Text] Eindhoven—The production of a hologram in the office environment is becoming a possibility. With the support of the Netherlands authorities, DHL (Dutch Holographic Laboratory), an Eindhoven company, has developed a holoprinter which is able to produce a three-dimensional [3D] print from a computer image within half an hour. Director Walter Spierings expects to have the equipment on the market by next year.

A year ago the Eindhoven-based company, which employs only four people, already scored a world first with the delivery of a two-step holoprinter to the Academy of Media Arts in Cologne, Germany. A PBTS [Program for Business-Oriented Technology Promotion] subsidy of 200,000 Dutch guilders enabled DHL to further develop the technology with a view to producing a convenient, desktop holoprinter for office use. At the moment the final details are being worked on. "We have proved that it works. This summer the images were good enough to make the idea commercially attractive. By the end of this year we will have a prototype which will, so to speak, only need a casing to go round it," declared Spierings.

The configuration in DHL's laboratory consists primarily of a SiliconGraphics workstation, an LCD [liquid crystal display] screen, and a laser device. An adapted version of the "Traces" software package, used for animation and rendering, installed on the workstation produces the appropriate 3D images and then generates the middle stage, the transfer hologram. That is displayed on an LCD screen and finally converted by the laser into a hologram.

At a large international conference held recently in San Jose, California, United States, it was revealed that the media laboratory at the Massachusetts Institute of Technology (MIT) was on the same track. "It is a competition, a race," according to Spierings, "it gives quite a kick to learn at such a conference that you are not inferior to them." MIT is working primarily on moving holographic images.

#### Making Ends Meet

DHL is looking for a suitable partner to be able to prepare the product for the market. "That is quite a business for a company with only four employees. With the help of the PBTS subsidy, we were able to concentrate for several months solely on the development of the holoprinter. But now we are under pressure again to produce holograms in order to make ends meet."

The equipment will cost about 100,000 Dutch guilders, excluding the workstation, but Spierings expects the price to drop very quickly to about half that amount. It depends to a very large extent on the progress being made in the fields of lasers and LCD screens. Dupont is currently developing holographic films that use a dry development process and are also sensitive to red light, which would allow the use of a cheaper helium neon laser.

DHL is working together with a number of universities and company laboratories and expects them to be the first to show interest. The holoprinter offers possibilities to building and construction designers and can deliver images of medical NMR scans, molecular structures, or air or liquid flow patterns in less than no time.

The hologram is also gaining attention as a medium for security and identification. The technique developed by the Eindhoven company makes it possible to turn video images into 3D passport photographs. The Central Criminal Investigation Department has already expressed interest in the system.

#### DEFENSE R&D

##### French Navy To Equip Reconnaissance Aircraft With Flir Chlio

93WS0412C Paris *LA LETTRE HEBDOMADAIRE DU GIFAS* (supplement to *LE BULLETIN DU GIFAS*) in English 25 Feb 93 p 2

[Text] DGA and the French Navy have re-asserted confidence in THOMSON-TRT Defense by placing an order for the gyrostabilized Flir Chlio to equip carrier-based BREGUET Alize reconnaissance and surveillance aircraft. The Flir Chlio, already in service with the French Air Force, on various types of helicopters, and already delivered to DGA for the Light Aviation Division of the French Army, is used for long range day or night identification of marine targets. It is employed during such missions as maritime patrol, seek and save operations over water or land, surveillance of sensitive

areas and points and, in general as an aid for piloting, observation, detection, reconnaissance and identification. The Flir Chlio embodies all the experience acquired by THOMSON-TRT Defense with the Flir Tango used with the maritime patrol aircraft Atlantique 2 of the French Navy Air Force and now to equip carrier-based aircraft. The Flir Chlio consists of a thermal camera developed by THOMSON-TRT Defense using SMT modules (Système Modulaire Thermique) shared by THOMSON-TRT Defense and SAT, plus a gyrostabilized platform supplied by SFIM Industries and numerous electronics processing lines developed by THOMSON-TRT Defense.

##### France: Thomson-CSF Develops Inter-Army Communications Network

93BR0457 Paris *ELECTRONIQUE INTERNATIONALE HEBDO* in French 25 Mar 93 p 13

[Unattributed article: "Military Telecommunications: Thomson-CSF To Lead 6-Billion-French-Franc Program"]

[Text] The French General Armament Directorate has just confirmed its decision to implement the Socrate program, an inter-army telecommunications network which will become operational between 1995 and 2000. This network will link the individual networks of the various Army corps (Ground Forces, Air Force, Navy, Gendarmerie) and will interconnect with the main national telecommunications systems (RITA [Integrated Automatic Transmission Network] for the mobile component and Syracuse [Satellite Radiocommunications System] for the space component) as well as allied European networks. Socrate's transmission infrastructure uses directional radio links and fiber optics and is based on ATM [Asynchronous Transfer Mode] switching. The program will last until 1996, with Thomson-CSF in charge of its industrial management, while most of the fiber-optic network meshing component will be developed by France Telecom. Program costs will run to about 6 billion French francs [Fr], half of which have already been committed since 1987 as part of modernizing efforts within each Army corps. The remainder of the budget will be used to ensure that these modernizations are carried out and integrated into the Socrate network.

#### ENERGY, ENVIRONMENT

##### France Launches River Purification Program

93WS0313A Paris *AFP SCIENCES* in French 11 Feb 93 p 36

[Text] Paris—The "Ile-de-France Clean Rivers" program will spend 10 billion French francs [Fr] over the next five years on water purification in the "Ile-de-France Clean Rivers." A financial partnership agreement to underwrite the program has been reached between the Seine-Normandy Water Agency, the

Regional Council, and the eight administrative departments that make up Ile-de-France.

The Seine-Normandy Agency, which is the biggest of the six that exist in France, will contribute Fr6 billion, including two from the Regional Council. The five-year contract—which specialists described as “unprecedented”—was cosigned 8 February by Ile-de-France’s prefect Christian Sautter, who is the president of the Seine-Normandy Water Agency’s board of directors, and Regional Council president Michel Giraud.

The program will spend its Fr10 billion over five years to build “high-performance” purification stations (notably in Colombes, in Hauts-de-Seine) that can treat waste water “in keeping with European standards: Zero breakdown, zero nuisance (neither smells nor noise).”

The high-performance stations will cost nearly Fr2 billion to construct and will be able to treat “the pollution of a million Paris and Haut-de-Seine inhabitants.” According to their promoters, the largely underground installations’ technological qualities and compatibility with their surroundings will make them “the first of their category in the world.” The plants will take up only 5 hectares of space, and will have gardens on the surface.

The joint policy to combat waterway pollution in the Paris region, decided upon by the Seine-Normandy Agency and the Ile-de-France Regional Council, aims to “totally eliminate the release of waste or surface water that has not been previously treated by a purification station into any river whatsoever.” The state, the Seine-Normandy Water Agency, the Regional Council, and other partners including departments and water distributors are setting up an Ile-de-France Regional Clean River Observatory to monitor “the effect of the work called for by the contract.” It held its general formation meeting on 8 February.

#### UK To Test Underwater Turbine

93WS0313B Paris AFP SCIENCES in French  
18 Feb 93 p 20

[Text] London—After tidal-powered factories and wave and river energy, the advent of underwater turbines that use the energy of ocean currents to generate electricity is almost upon us. At least it is in Great Britain where, early this summer, engineers of the IT Power of Eversley company in Hampshire are going to test the new concept at the mouth of a loch on the western coast of Scotland.

According to specialists of the Harwell Energy Technology Support Unit, who are cited by THE TIMES of London, this type of turbine could meet up to 17 percent of Britain’s energy needs. The turbines use the currents along the coasts, which run as fast as 3 meters a second.

If the scheduled test is conclusive, the concept could also be used extensively abroad. The trial will be conducted jointly by Britain’s engineering laboratories and Scottish Nuclear, which is underwriting most of the cost.

The system employs a mooring buoy, to which a turbine and its electrical generator are attached at a depth of six meters. The turbine will be driven by a two-blade propeller moved by the current. The concept, its promoters stress, is based on necessary existing technologies.

#### France Sanctions Rapeseed Diesel Fuel

93WS0313C Paris AFP SCIENCES in French  
18 Feb 93 p 20

[Text] Paris—“Green fuel” is getting off to a cautious start in France. The state and oil groups Elf and Total agreed on 11 February to support the use of rapeseed ester in diesel engines, a move that was recommended—with some reservations—by Raymond Levy in his report on biofuels that was made available to the press on the same day.

Agriculture and energy ministers Jean-Pierre Soisson and Andre Billardon signed an agreement with Elf, Total, and plant oil producers that calls for the production of 120,000 tons of rapeseed ester within three years. The ester is primarily earmarked for city buses, and will be made exclusively from rapeseed grown on land that has theoretically been laid fallow by Europe’s new agricultural policy. For 120,000 metric tons of ester, that means 100,000 hectares. The state will pay farmers 25 million a year to make rapeseed cultivation profitable (800 to 1,000 French francs [Fr] a hectare). It is purchasers, and thus cities, that will have to pay the added cost (50 centimes a liter) of the gasoil-ester mixture, which contains 5 percent ester.

In the report Prime Minister Pierre Beregovoy asked him to make last fall, Renault’s former CEO describes the value of biofuels as “exclusively agricultural.” He cautiously recommends developing rapeseed ester. According to Mr. Levy, biofuels have no short-term energy or economic advantage and little influence on the environment.

#### Germany: Siemens-Nixdorf Builds Environmentally-Friendly Modular Components

93WS0365A Duesseldorf VDI NACHRICHTEN in German 12 Mar 93 p 20

[Article: “Environmental Protection Integrated into Manufacturing Saves Production and Disposal Costs”]  
[Text] VDI-N, Paderborn, 12 Mar 93—A fixed component of product development at Siemens Nixdorf Information Systems AG [SNI] is the experimental values and guidelines being worked out with the involvement of the new recycling center. Plant manager Peter Feldweg already sees in this the charting of a course whereby it will be possible to have environmentally-friendly manufacturing and recycling at the end of the product’s “life cycle.”

This is why already in the definition and development stage Paderborn designers select all plastics that are used on the basis of ecological criteria. “Non-recyclable or

hardly recyclable materials, such as duroplasts, for instance, are not incorporated into SNI products," says Feldweg. Additionally, all modular-built SNI system components are plug-in. Not only does that save on connecting cables, it also guarantees easy separability in later recycling processes.

Feldweg cites the switch from spraying to dusting of metal parts as a striking example of the use of environmental protection integrated into product manufacturing. Using the conventional method, more than 100 t of lacquer sludge had to be cost-intensively disposed of. Dusting has succeeded in almost entirely avoiding that problem substance. With practically 100 percent use of dusting material, less than one ton now requires disposal.

Paralleling this sizable reduction was the success in perceptibly lowering the volume of air required for the coating process, thereby also saving large amounts on energy. Since powdered lacquer is now electrostatically applied to the metal parts and the lacquer coating is then accomplished only through heating, the atmosphere is no longer charged with environmental pollutants. According to Feldweg, it is presently possible largely to dispense with the nearly 100,000 m<sup>3</sup>/h of fresh air in the spraying compartments that was preheated to 20°C. The plant manager estimates total fresh air savings in the lacquer sector at 50 percent. The processing changeover also significantly reduced the volume of effluents since dusting renders water-flushed spraying compartments superfluous.

#### France, Germany Sign Nuclear Safety Pact

93WS0388A Paris AFP SCIENCES in French  
11 Mar 93 p 24

[Article: "Franco-German Accord on Radiological Emergency Situations"]

[Text] Paris—Pursuant to an agreement reached between the INTRA group (consisting of EDF [French Electric Power Company], COGEMA [General Nuclear Materials Company] and IPSN [National Institute of Nuclear Protection and Safety]) and its counterpart KHG (Kerntechnische Hilfsdienst Gesellschaft), the French and Germans will cooperate and increase their mutual assistance in the event of a radiological emergency situation resulting from a nuclear accident.

An IPSN release on 4 March stated: "The object of this pact is to enable each of the two partners to strengthen its ability to respond to an accident by calling upon the means that the other partner has at its disposal in terms of manpower and equipment. The equipment to be shared consists of radiological survey and measurement robots, as well as remotely controlled civil engineering equipment designed for work in a hostile environment."

This new pact details and supplements the cooperation that existed between the two agencies. In addition, it provides for conducting joint exercises, exchanging of information, and the organizing of a restudy of testing.

KHG is a jointly-owned subsidiary of the 15 German nuclear operators. It was formed in 1977 for the purpose of setting up and managing a pool of in-service facilities to be rapidly deployed in case of a nuclear plant accident.

#### Europe Launches Geothermal Energy Research

93WS0388B Paris AFP SCIENCES in French  
11 Mar 93 p 30

[Article: "European Geothermal Research Program"]

[Text] Soultz-sous-Forets—A gigantic natural steam percolator connected to a turbine: Under a European research program, geothermal energy will have a go, on the Alsace plain, at demonstrating its industrial viability.

The principle is simple: At more than 3,000 meters underground, a granite platform traversed by numerous faults forms a giant radiator whose temperature reaches almost 200 degrees. Injecting water under pressure is sufficient to produce an outflow of steam that will drive a generator.

The Soultz-sous-Forets (Bas-Rhin) experimental site is in the middle of old oil fields in Alsace that were exploited until the end of the 1960s. This region of the Rhine trough is characterized by a strong underground thermal potential on a line running from the foot of the Vosges to Worms in Germany. The production of electricity in this form would constitute a first in metropolitan France (one such power station already exists in Guadeloupe).

The production of electricity by means of solar or wind power can be reckoned in kilowatts; that is to say, on the scale of the needs of a few homes. The power that geothermal energy can release makes it an energy source of truly industrial proportions. "It is measurable on the scale of hundreds of kilowatts; that is, by units of measure comparable to the classic power stations," says Mr. Alain Gerard, who is in charge of the Soultz-sous-Forets project.

The production cost of geothermally-generated electricity remains slightly higher than that of the classic system. "But if the cost of amortizing the building of a geothermal station is put on the same plane as the price of fuel of a power station, it quickly becomes evident that the geothermal solution is viable," says Mr. Gerard.

Around the beginning of the year, a boring was sunk, first through the sandstone then through the granite, to a depth of 3,590 meters. This was the first stage of the program that, in 1995, is to launch a pilot plant that will precede the construction of a 10-megawatt prototype around the end of the decade. For production on an industrial scale, the number of wells will have to be increased to yield a sufficient flow of steam.

"With about 50 wells, each 25 cm in diameter, some 100 megawatts can easily be produced," according to Mr. Gerard. As for the future: "Within a few tens of years,

geothermally-generated electricity can be developed to rank as a serious alternative to nuclear energy," says Socomine's manager.

The cost of the research program will total around 35 million French francs [Fr], 55 percent of which will come from the EEC, 20 percent from French sources, and 15 percent from Germany. The remaining 10 percent is to be brought in by British institutions in the form of equipment (instruments, sensors, etc).

#### **Undersea Power Plant To Provide Electricity to Southern Italian Regions**

*93MI0389 Bonn DIE WELT in German 25 Feb 93 p 9*

[Article by Andreas Englisch: "Electricity From the Mediterranean: Power Station To Be Built on Seabed Between Sicily and Italian Mainland"]

[Text] Neither the Po nor the Tiber river has the greatest water flow in Italy. The most powerful current under Italian sovereignty, with the greatest flow speed, surges at a depth of around 100 meters on the seabed between Punta Pezzo and Ganzirri through the Straits of Messina, separating Sicily from the Italian mainland.

This submarine current is to drive Europe's most spectacular power station. The marine research institutes in Catania and Reggio Calabria estimate that water volumes of around a million cubic meters per second are forced at speeds of three to five meters per second over the seabed through the Straits of Messina. Every six hours the tides change the current's direction. Elio Matacena, president of the Ponte d'Archimede company, states that "the German Voith company is to supply us with 100 turbines for electricity generation. We plan to build a power station on the seabed, to convert the water current into electricity." Together with three other firms, Ponte d'Archimede has set up the Enermar company, which has devised the project. Offshore technology will be used to anchor concrete blocks to the seabed, leaving open gates through which the water will flow setting in motion four sails mounted on round rotating platforms, which will drive the turbines. These sails will make efficient use of the water current when the direction of flow changes. The power station is to be constructed on the seabed for the entire three-kilometer distance separating the mainland and Sicily, and will attain an output of 100 megawatts, supplying electricity to the surrounding cities of Reggio Calabria or Messina. The worst-case price of the seabed electricity will be around one German mark [DM] per kilowatt hour; Matacena states that "if the sea current is constant and somewhat stronger than our worst-case projection, then we shall achieve a competitive price." In the best case, the price could be below 27 pfennigs. It is not yet clear, however, which of the two cities will benefit from this cheap electricity. If the EC is willing to support the project, then a pilot project will start before the end of 1993. Two turbines will initially be anchored to the seabed, at a cost of under DM60 million. "We need the

pilot project to test just how strong the submarine current actually is," explains Matacena. Italian planners believe that the modest scale of the Messina Project could make it a model for a pan-European power station on the seabed of the English Channel, separating England and France. Norway has also shown interest in the project: many Norwegian fjords have a very strong seabed current.

#### **Germany: Reactions To Chemical Disaster Caused By Hoechst**

##### **Environment Minister's Position**

*93MI0399A Munich SUEDDEUTSCHE ZEITUNG in German 2 March 93 p 1*

[Text] Following last week's accident, Federal Environment Minister Klaus Toepfer (CDU [Christian Democratic Union]) has described the information policy of chemical company Hoechst AG as "unsatisfactory." Toepfer stated on Monday that he plans to ensure that the case is investigated with appropriate documentation, by the Accident Commission. The so-called "waste substances" inquiries also needed to be speeded up, he stated. Ortho-nitroanisol, the substance discovered at Hoechst, had previously been investigated, and the results had been available to Hoechst. "We were surprised that this information was not made public," Toepfer added.

##### **Major Contamination Avoided**

*93MI0399B Munich SUEDDEUTSCHE ZEITUNG in German 2 Mar 93 p 2*

[Text] A week after the severe chemical accident at Hoechst's factory in the Frankfurt district of Griesheim, clean-up operations are well in hand, according to the fire department. Reinhard Ries, head of the Frankfurt Fire Department, stated that he believed that the worst contamination had now been removed. Hoechst AG stated that 4.5 percent of the substances which escaped a week ago had still not been identified. Toxicologists have been advising Hesse's Environment Ministry in Wiesbaden on the consequences of the accident, the results of which remain as yet unknown.

Ries stated that decontamination of roofs in the contaminated district of Schwanheim would continue, and that the fire department had issued an all-clear over air pollution, which meant that air pollution by chemicals was below the detectable level. A total of 400 cubic meters of soil, shrubs and bushes have been removed, and removal of the bank of the River Main at Schwanheim will soon be completed. The roughly 200-strong company fire department at Hoechst have now started removal of the asphalt surfaces of badly contaminated roads.

A Hoechst spokesman stated that all but 4.5 percent of the substances released in the poisonous cloud had now been analyzed; he added that the accident-stricken plant,

built in 1952, was not equipped with an acoustic alarm, and the most recent approval by the health and safety authorities had been granted "at the end of the eighties." The Environment Ministry had called on the company to implement safety measures which "could take immediate effect" at similar plants. At the weekend, Hoechst confirmed that it had information about the carcinogenic effects of ortho-nitroanisol in November 1992.

In Wiesbaden, Environment Minister Joschka Fischer of the Green Party called a meeting of leading toxicologists and representatives of the Federal Environment Agency, the Federal Health Agency, the Federal Agency for Industrial Health and Safety, the Federal Environment Ministry and other bodies. According to the ministry, the toxic and ecological properties ortho-nitroanisol and the other substances released were discussed.

#### Dutch-Russian Venture Develops Functional Thermionic Energy Conversion System

93BR0411 Rijswijk POLYTECHNISCH WEEKBLAD in Dutch 12 Feb 93 p 1

[Article by Bart Stam: "Thermionic Energy on Its Way; Cooperation with Russian Institute Produces Breakthrough in Development at ADENCO [Advanced Energy Conversion]"]

[Text] Eindhoven—A completely new energy system is on its way. Thanks to a successful Russian-Dutch collaboration, the first central heating boilers and industrial burners to make use of thermionic energy conversion [TEC] will be ready by the end of 1993. The method is a revolutionary one in which heat is directly converted into electricity without involving any moving parts.

He who laughs last, laughs best. The expression is indelibly printed on Engineer L.R. Wolff's brain. Since 1978, he has been working on getting thermionic energy conversion off the ground by trial and error. He worked first as a researcher at the Chemical Physics laboratory at the Technical University of Eindhoven, and from 1987 with ADENCO (Advanced Energy Conversion), a company which he founded together with two partners.

#### Support

Shortage of funds, together with a skeptical attitude from large-scale industry in particular, have not been able to discourage Wolff from continuing with thermionic energy conversion. However, over the last few years, the prospects for ADENCO have become more hopeful. The Ministry of Economic Affairs has granted a technical development credit of 875,000 Dutch guilders to Energy Conversion Systems [ECS], the joint venture set up between ADENCO and the Russian IPPE (Institute of Physics and Power Engineering) in Obninsk.

In the meantime, the PNEM [Province of North Brabant Energy Company] has also promised financial support.

The North Brabant energy concern is aware of the possibilities to be gained from installing both smaller and larger central heating boilers in private houses, greenhouse market gardening centers, and public buildings. That is why the PNEM intends to install a 50-KWe demonstration model this year at its new district office in Oss. According to Wolff, there is a very good chance that other energy concerns will jump on the bandwagon.

Honeywell and the metal company Philips Mecoma have already expressed industrial interest in the supply of thermionic systems components. At the moment, Honeywell is carrying out a market investigation, while Philips Mecoma is preparing a cost estimate for the mass production of the thermionic energy converter.

#### Edison

Thermionic emission is a physical phenomenon that was discovered by Thomas A. Edison. The famous inventor found that there is a difference in voltage between the hot and cold filaments in a carbon filament lamp. Current TEC systems are based on this principle, which consists of a diode in which one electrode—the so-called emitter—is heated to about 1,450°C. At this high temperature, the emitter thermally emits electrons that are captured by the second electrode, or collector, at 600 degrees. The resulting difference in voltage forms the basis of the eventual production of electricity.

The principle of thermionic energy conversion appears to be very simple, but according to Wolff a great deal of technological development is necessary to produce workable systems. He gives as an example the emitter's material, which, because of the high temperatures, must be chosen very carefully in order to obtain the correct heat transfer. Wolff and his coworkers developed the Cermet emitter in 1980, which consists of wolfram and lanthanum chromate, a project for which they received the BP [British Petroleum] Energy Prize in 1982.

Wolff calls the collaboration with IPPE an important breakthrough in TEC's development. For years, this institute has been at the absolute top in the Soviet Union in the field of nuclear energy. IPPE worked under the greatest secrecy on the development of a thermionic nuclear reactor, which could successfully be used to power military spy satellites.

Since then, the institute has for the greater part switched over to civilian research. Nevertheless, 300 of the 10,000 employees are still working on TEC. "That is more than in the rest of the world put together," said Wolff. In 1988 he was approached by Dr. Valery Yaragin, head of the IPPE's thermionic laboratory, about working together. "He knew that here in Eindhoven we had gained experience in materials development for smaller flame-heated TEC systems. That fitted in well with their knowledge of larger devices." The contact resulted in the foundation of the Energy Conversion Systems joint venture in August 1991.

### No Complaints

The Dutch-Russian cooperation can be called sensational. While ADENCO has taken care of the financing and management, IPPE has been carrying out a great deal of the research. There are no complaints to be heard from Wolff, only enthusiastic stories about technological collaboration with Russia. "As managing director of ECS, I go on average once a month to Obninsk. The self-motivation of the staff there is impressive. Because 50 well-trained people are working full-time for ECS, IPPE can work on different aspects at the same time. That would be virtually impossible in the Netherlands. Above all, it would cost us so much more in salaries."

### Supplementary

ECS has three trumps in the final mass production of TEC systems. The first is the relatively small-size central heating boiler for use in private houses. The second, a large central heating boiler for the greenhouse market garden industry, for instance, or nursing homes. The third one is the development of the industrial burner. All cases involve applications of up to 125 kWe. "Above that capacity, we are defeated by conventional heat/power units, which are more efficient for the time being." The efficiency of TEC systems (10 percent) is, according to Wolff, restricted by the transfer of radiant heat between emitter and collector. "TEC systems are, however, an excellent supplement to existing heat/power units in systems with smaller power requirements," he said. He mentioned as advantages the limited maintenance due to the lack of moving parts, no noise nuisance, and less discharge of  $\text{NO}_x$  and  $\text{CO}_2$ . It remains to be seen, however, whether the total market for thermionic systems in the Netherlands is really as large as 3,000 MWe, as the Heat & Power Project Bureau has calculated. "Among other things, that will depend on the costs of mass production," said Wolff, who will not venture to make a prophecy on this point.

### German Ministry Funds Aviation Pollution Research Program

93MI0418 Bonn TECHNOLOGIE-NACHRICHTEN MANAGEMENT-INFORMATIONEN in German  
19 Feb 93 pp 5, 6

[Text] The BMFT [Federal Ministry of Research and Technology] is funding a joint Aviation Pollution program. On the one hand, scientific atmospheric research studies are set to improve our knowledge of the effects of aircraft emissions into the atmosphere and, on the other, studies of engine technology are to create the conditions for reducing pollution from air traffic.

The BMFT is funding over 20 projects under the Atmospheric Research subprogram. A total of approximately 12 million German marks [DM] has been authorized for three years. In addition, the partners from industry, the major research institutes, the Max Planck and Fraunhofer societies, the universities, and other institutions are providing their own resources to an approximately equal level. The

German Aerospace Research Institute (DLR) is coordinating the scientific work and the program.

Work under the Engine Technologies subprogram was initiated by the funding of five basic research-oriented projects on combustion chamber technology to the tune of around DM3.1 million under the BMFT Aviation Research Program.

The Atmospheric Research subprogram determines pollution emissions, the propagation of the pollutants, and their effects. By about 1995, it will be possible to assess the risk potential from air traffic much more reliably than is the case today. It will mean setting up databases in which the emissions from individual engines in all operating states and the movement sequences of global aviation are recorded and linked together. The chemical processes in the air are complex and varied. The dominant processes and interactions during pollution discharge and transportation have to be identified and described in their orders of magnitude against the background of natural emissions and concentrations. Atmospheric computer models must be extended and refined with respect to current formulations (includes three-dimensional instead of two-dimensional, and reduction of the currently still very rough grid widths). Measurements must be made at relevant flight altitudes, to verify and further develop the computation processes so that recording of the propagation of pollutants can approximate more closely to reality, and their effects on the earth's radiation management can be quantified.

Air transportation is also being included in discussion of the greenhouse effect and the hole in the ozone layer.

The current fuel consumption of the world's civil air traffic is estimated at approximately 180 million tonnes. During operation, an aircraft engine produces the known greenhouse gases carbon dioxide ( $\text{CO}_2$ ) and water vapor ( $\text{H}_2\text{O}$ ), and a series of other pollutants such as nitric oxide ( $\text{NO}_x$ ), carbon monoxide (CO), unburned hydrocarbons ( $\text{CH}_x$ ), smoke, and other trace elements (sulfur dioxide, additives).

Since the introduction of jet engines in the sixties, the specific fuel consumption of modern engines has been almost halved, together with a corresponding reduction in carbon dioxide and water vapor emissions, and other pollutant emissions have also declined in proportion to nominal thrust. Nitric oxide emissions have, however, remained constant, owing to the trend towards higher temperatures and pressures to enhance efficiency. Since air transportation is increasing at a disproportionate rate (transport capacity rose from 920 billion passenger kilometers (pkm) in 1978 to 1,900 billion pkm in 1990, and is set to double again by 2005), the absolute pollution emissions are also increasing.

Although air transportation, both civil and military, has a share of less than 2 percent in overall energy consumption worldwide, travel at high altitudes is expanding. In the upper troposphere and lower stratosphere, air traffic is the only direct emitter of anthropogenic pollutants,

i.e., those caused by mankind. Unlike pollutants emitted close to the earth, which are washed away by rain, emissions introduced at high altitudes have very long dwell times. This particularly applies to water vapor and nitric oxides. Compared with the low natural water vapor concentration, the water vapor emanating from aircraft is a considerable form of pollution, which is frequently also visible in the form of vapor trails, and can rise to the ice clouds that intensify the greenhouse effect. Nitric oxides, on the other hand, affect the ozone content of the atmosphere. Whereas they raise the ozone content in the troposphere, they contribute to ozone depletion in the stratosphere.

At our current level of knowledge, it is not clear whether we can accept engine emissions when considering climatic effects, or whether remedial measures will be necessary. All this is against the background of both the forecast growth in world air transport and improvements stemming from the possible introduction of supersonic flight, which is under discussion especially in the United States. The BMFT's joint Aviation Pollution program is intended to make an essential contribution, both in improving our knowledge and as a basis for possible action.

Further information is available from Herr Schmidt, Environment Research Project Manager, DLR, Sudstrasse 125, D-W-5300 Bonn, Germany, tel. 0228/3821-224.

#### Netherlands Firm Uses CFC-Free Foam Production Process

93BR0421 Rijswijk POLYTECHNISCH WEEKBLAD  
in Dutch 19 Feb 93 p 1

[Article: "New Foam Production Process Operates Without CFC Frothing Agents"]

[Text] Kersteren—Last week, the polyurethane foam manufacturer Recticel Nederland began to use a new process which produces soft foam without requiring the usual CFCs (chlorofluorocarbons). It is the first installation of this kind in the world.

Recticel started work on the project in 1990, with support from the Ministry for Housing, Planning, and the Environment. The goal was to reduce the emissions of CFCs, a negative byproduct of conventional foam production processes. In all, the Kersteren artificial foam manufacturer invested 7.5 million Dutch guilders on the development of its Variable Pressure Foaming (VPF) process, which has resulted in an interesting, fully controlled foam production method which requires no CFCs.

#### Crucial Tricks

One of the most crucial tricks in the VPF process has been the decision to use low atmospheric pressure. Experience showed that the foaming process improved at a lower pressure, and Recticel made this the basis of

the new process. The principle consists in creating a low-pressure environment, or partial vacuum, in which the foam develops naturally without needing a CFC frothing agent during the rising stage.

The implementation of this principle has not, however, been easy. It required a sort of airtight reactor shed, 100 meters long and with a capacity of 800 cubic meters. Here, 15,000 tons of soft foam can be produced annually in blocks measuring 2 by 1.8 by 30 meters in size. The installation is suitable for different types of soft foam.

Recticel thinks it will be capable of producing a completely new generation of high-value soft foam. Under (specific) low-pressure conditions, the foaming process apparently produces a foam with new, specific characteristics, such as complete openness of the cells, greater elasticity, and better longevity. The Recticel installation is completely gas-proof; it is operated automatically without using CFCs or CFC substitutes (such as dichloromethane or HCFCs) and is connected to an installation which collects and eliminates gasses emitted during the production process.

#### Frothing Agent

Recticel Nederland is also one of the participants in the "CFC-less" campaign which was initiated this year and is an initiative of the Netherlands Association of Polyurethane Rigid Foam Manufacturers (NVPU). The campaign requires all NVPU members to produce only CFC-less PUR [polyurethane] rigid foam. With this campaign, the NVPU claims to be ahead of the European directive, which will not require CFC-less production until the beginning of 1995. The four manufacturers within the NVPU (in addition to Recticel, these are Vapotherm BV, Sellink Isochemie BV, and Opstalan BV) intend to use pentane instead of CFCs as a frothing agent.

#### German Architect Builds Sun-Tracking Solar Powered House

93MI0433 Munich SUEDDEUTSCHE ZEITUNG  
in German 11 Mar 93 p 33

[Text] Architect Theddo Terhorst has built a house that turns towards the sun like a flower in Rhein near Muenster. As soon as the sun is higher again in northern Europe, the rotation system will pay, Terhorst believes, as the movement of the pyramid-shaped house about its own axis will enable the 12 square meters of roof-mounted solar cells to generate about twice as much electricity as the photovoltaic systems installed in stationary houses. He expects a power output of about 1,500 W/h in good weather. The house turns imperceptibly, at the rate of five centimeters a minute. The electric motor that rotates the 180-tonne building uses only approximately 1 percent of the self-generated power, costing only five pfennigs a day to run, says Terhorst. This modest consumption is achieved by a sophisticated gear system with a high conversion rate of 1:13,636 that transfers the rotation of the motor to a

"turntable" whose tracks rest on rollers let into the foundations: the same technique used to move locomotives in marshaling yards. The house has a floor area of 153 square meters and costs in the region of 550,000 German marks.

### Germany: Prospects For Environmental Engineering Reviewed

93MI0440 Bonn *DIE WELT* in German  
12 Mar 93 p 14

[Article by Ute Semkat: "Booming Market for Environmental Technology"]

[Text] The site of the "Terratec" environmental trade fair is a mass of green, with 641 companies from 17 countries presenting their latest environmental technology. Almost one in every two German exhibitors is based in the new laender.

The market for environmental technology is booming, with around 280 billion German marks [DM] needing to be invested in eastern Germany over the next 10 years in water treatment, garbage dump construction, reclamation of contaminated sites and energy supply. In western Germany, DM380 billion will in the future be invested in creating an environment-friendly infrastructure.

Besides prestigious major companies, many medium-sized firms are also represented. Established firms are skeptical, however, about the rush into this apparently unlimited future market, primarily because these entirely publicly-financed contracts are proving slower to materialize than expected. The reason for this delay, apart from "administrative dilemma," is stated to be the local councils' fear of funding evaporating, together with the new laenders' imminent local governmental reform.

East German companies active in areas ranging from engineering to chemicals discovered the environment in 1990, seeing it as a new area offering scope to compensate for the collapse of their traditional core industries. Sket AG of Magdeburg has expanded its modest recycling business beyond road construction into abandoned automobiles, garbage, and sewage sludge. Similarly, the former research department of DDR [GDR: German Democratic Republic] Agricultural Machinery, now known as Agritechnik, based in Neustadt, Saxony, is using its experience of process technology and its home advantage in selling compact environmental clarification plants.

Those just entering the market are regarded with some suspicion by established firms such as Thuringian Environment Technology GmbH of Sonnenberg, whose 40 employees generated around DM40 million of revenue in 1992. Financial Manager Dieter Bauer feels the market suffers from "distorted relationships": He points out that "for more than 20 years, around 50 firms

supplied west German homes with drains and sewerage equipment—whereas up to 100 are now bidding to supply the new laenders' 16 million inhabitants."

### German Holding Builds Large Coal Power Plant in South Africa

93MI0444 Bonn *DIE WELT* in German 4 Mar 93 p 14

[Article by Juergen H. Wintermann: "Light for the Cape of Good Hope—4,000-Megawatt Coal-Fired power Station Built in South Africa With German technology"]

[Excerpt] [Passage omitted] In power generation in particular, Germany has something to offer South Africa in its pursuit of progress: the best in coal technology with the world-record efficiency for conversion into electricity. And all at competitive prices. On the Cape of Good Hope, German firms are fighting the entire international competition for orders.

At the end of 1983, the Ratigen-based firm Balcke-Duerr AG (BDAG), in conjunction with DB-Thermal Pty., Johannesburg, part of the Deutsche Babcock group, pulled off a particularly big deal. It landed the 850 million German mark [DM] order to build the six dry cooling towers for the 4,000-megawatt Kendal coal-fired power station in Transvaal.

It was clear to the customer, the Electricity Supply Commission (Escom) that water—and thus cooling water—is in short supply in the region's coalfields. Wet cooling towers, which work by evaporation, were therefore out of the question. Forecasts of future water and coal consumption at Kendal showed that the water reserves would be exhausted long before the coal reserves.

The dry cooling tower, where not a drop escapes into the atmosphere, saves 130 megaliters a day, equivalent to the daily needs of a town with a population of 120,000, or, with six towers, a 2.5 million-strong city. The considerable additional investment will pay for itself in the medium term. Escom was won over by the Balcke-Duerr technology. The power station has already commissioned three of the six electricity generators. The last cooling tower will be completed in the next few weeks. Then it will be working at full load. The turbines were supplied by Siemens-KWU [Power Engineering Division]. With its six gigantic towers, each of which would hold Cologne Cathedral, Kendal is the largest plant in the world in the history of cooling technology. The cooling pipes are 420,000 km long, 1.4 times the distance between the earth and the moon.

South Africa will need new power stations by the next century at the latest. But already old plants are being retrofitted, with flue gas filter units as well. With Kendal as a reference, Babcock and Balcke-Duerr have a good chance of building them.

**Germany: Eco-Fridge Goes Into Mass Production**

93MI0451 Munich SUEDDEUTSCHE ZEITUNG  
in German 15 Mar 93 p 23

[Text] The world's first refrigerator without ozone destroying CFHCs [chlorofluorohydrocarbons] and the greenhouse gas CFC [chlorofluorocarbon] goes into mass production on Monday at Foron Household Appliances GmbH in Niederschmiedeberg, Saxony. The factory, which was under sentence of death six months ago, when it was called dkk Scharfenstein, and was to be liquidated by the Trust Agency after prospective purchaser Bosch-Siemens withdrew, has made a breakthrough in environment-friendly refrigeration technology and in so doing given itself a good chance of survival.

The industry's giants in western Germany have for several years been banking on the refrigerant R 134, which has no chlorofluorohydrocarbons but which, because of its chlorofluorocarbon content, contributes to atmospheric warming, otherwise known as the greenhouse effect. They also reacted negatively when, in 1990, two doctors from the Dortmund Hygiene Institute presented an environmentally harmless mixture of propane and butane as an alternative refrigerant.

**With Help From Greenpeace**

The environment protection organization Greenpeace supported the idea and searched a long time for a firm willing to test the environment-friendly refrigerant, until it hit upon the Trust Agency firm dkk Scharfenstein from Saxony. The Saxon firm, whose sales had slumped since the unification of Germany from a million refrigerators and freezers a year to 178,000 in 1992, accepted Greenpeace's proposal in April 1992.

Within a very short space of time, the dkk engineers developed an appliance with the new refrigerant. When news came from the Trust Agency in mid-July that potential investor Bosch-Siemens had withdrawn and dkk would subsequently be liquidated, the firm took the bull by the horns with the environmentalists' support. They presented the prototype "greenfreeze," as Greenpeace calls the new type of refrigerant, to the press at a press conference a few days later. Shortly afterwards, the environmental organization started a full-scale advertising campaign that brought about 70,000 advance orders. In August, a large mail order firm announced it had ordered 20,000 of the new fridges from Scharfenstein with an option on another 50,000. In 1993 Foron intends to build around 270,000 eco-fridges in 11 different models. If it manages to increase production to 300,000 in 1994, the firm will be in the black. The new fridge will cost around 600 German marks [DM] in the shops.

The Trust Agency gave way, too. In August it announced that it would maintain refrigerator production in the Erz Mountains and contribute DM5 million to develop the eco-fridge to the production stage. Then, in November, a buyer was found for what had been the former GDR's

only refrigerator manufacturer. The East German Investment Trust, London, a Berliner Bank consortium, and the company management, now trading under the name of Foron Household Appliances GmbH, are the new owners of this firm, which is fighting against all odds for survival.

West German manufacturers stuck to the view that using propane and butane was technically impossible. In November, the dkk engineers announced that, after many improvements, the propane/butane appliances now consumed 10 percent less power than fridges cooled with CFHCs. Other manufacturers have now also jumped on the eco-fridge bandwagon. At the Domotecnica household appliances fair in Cologne in February, competitors Bosch-Siemens and Liebherr for the first time exhibited appliances with the propane-butane mixture as refrigerant.

**Italian Firm Develops Recycled Plastic From Urban Waste**

93MI0446 Milan ITALIA OGGI in Italian  
15 Mar 93 p 34

[Text] We have now grown accustomed to the many surprises of recycling. However, the idea that comes from RPE of Reggio Emilia is indeed a strange one. The company has developed a plastic material (called Replex) from urban waste for use as a raw material in the construction of streetlight poles. The poles will be produced by a leading company in this sector, the Parma-based Tecnopali, which has decided to test Replex in this unheard of application as an alternative to traditional materials.

Tecnopali, with 50 billion lire in revenues and 130 employees, is one of ENEL's [National Electric Power Company] leading suppliers of streetlight poles.

"By using Replex we have developed a new product," said Tecnopali president Maurizio Grazioli. "It is a pole with a low environmental impact which is modular and can be recycled. The pole consists of several modules and because of this can assume any form wanted by the designer."

**Netherlands: Biological Flue Gas Desulfurization System Implemented**

BR1404114593 Rijswijk POLYTECHNISCH WEEKBLAD in Dutch 2 Apr 93 p 3

[Article by Gerard van Nifterik: "Biological Flue Gas Desulfurization System Gets Chance in Geertruidenberg"]

[Text] Balk—At the end of June, the Amercentrale power station in Geertruidenberg will launch a pilot project for a new type of flue gas scrubbing. It involves a biological process, developed by Paques BV., which will remove sulfur from the smoke produced by the coal-fired power station.

"It will be 30 percent cheaper," claims Dr. Engineer C.J.N. Buisman of the environmental technologies company Paques BV., located in Balk. "The process is about 30 percent cheaper than the conventional gypsum-based method. Not to mention the problems related to disposing of the gypsum, which has to be dumped somewhere, whereas the sulfur residue from our process simply can be sold."

In collaboration with Hoogovens, and financially backed by the Northern Development Company (NOM), Paques developed a process for removing the sulfur from the washing water in scrubbing plants. The only residue from this biological method is salable elementary sulfur.

The biological desulfurization of waste water is nothing new, but the desulfurization of washing water using the Paques method certainly is. The Paques method also requires very different process circumstances. The temperature of the waste water—about 50°C—is much higher than that of normal waste water. Its salt content, mainly NaCl, also is relatively high, which seemed reason enough to adapt the existing principle of desulfurization to the extreme washing water circumstances.

Those involved in the project have since developed a process provisionally known as Bio-FGD (flue gas desulfurization). This is a multistage process in which the washing water from the scrubber is first anaerobically purified in a Biopaq IC reactor, where the sulfur dioxide is converted into sulfide. The next aerobic step, in a Thiopaq reactor, turns this into elementary sulfur, which is purified before being sold.

Laboratory results will be confirmed from the end of June onwards. A pilot plant will be set up at the coal-fired power station in Geertruidenberg. It will handle approximately 4,000 cubic meters of flue gases per hour—1 to 2 percent of the station's total emission level. If everything goes according to plan, the system's capacity will be increased after a year of experimental operation.

## FACTORY AUTOMATION, ROBOTICS

### FRG: Experts View Future Industry Automation, Organization Needs

93WS0331A Berlin WT—ZEITSCHRIFT FUER INDUSTRIELLE FERTIGUNG Feb 93 pp 26-27

[“Production Technology in the 21st Century”]

[Text] *Industry in Germany is in trouble. It is searching for ways to meet new challenges. Because of German reunification and the momentary loss of entire markets in Eastern Europe, many businesses in Germany are confronted by problems that they can only handle with great difficulty or with foreign aid. Besides solutions and ideas for the short and mid term, what is most needed are policies and strategies that will open the way to the future and long-term investments and help to secure long-term*

*investments. Besides technical changes, new organizational concepts are especially needed for our factories.*

In early November 1992, the Fraunhofer Institute for Production Technology and Automation (IPA), Stuttgart, invited the professional community to view the latest research developments in production technology. The two-day exhibit ran under the motto "Research and Development for Production." A high point of the exhibit was a two-hour panel discussion, which, entitled "Production Technology in the 21st Century," evoked great interest. Participating in the discussion were: Prof. Dr.-Eng. Walter Kunerth, chairman of the board of Siemens AG, Regensburg; Dr. Berthold Leibinger, business partner of Trumpf GmbH & Co. Machinery Plant, Ditzingen; Dr. Leonhard Vilser, director of the vehicle-heating department at J. Eberspaecher, Esslingen; and Prof. Dr. h.c. mult. Dr.-Eng. Hans-Juergen Warnecke, director of the Fraunhofer Institute for Production Technology and Automation, Stuttgart. Dr. Tilmann Achtach, economic editor of the Sueddeutsche Rundfunk (South German Radio), Stuttgart, acted as moderator.

### More Collegial Spirit and Fewer Prophets are Needed

Dr. Berthold Leibinger began his introductory statement with the words, "Germany is a very expensive country for manufacturing." Leibinger predicted that Germany will become a country that in the long term will produce only high-value products. The manufacture of components of simple products will, for the most part, be done outside of Germany. To do that, a swift-acting association of well-organized and logically interdependent companies is required. Aside from such global speculations, Leibinger is mostly concerned with company internal problems. He expounded on several themes dealing with future development:

- The product development times required have to be halved in several branches of industry;
- Investment risks in new developments can be reduced by getting the products on the market rapidly and at the right time;
- All departments of a business should be consulted on the matter of product development and company strategic actions;
- Complicated manufacturing processes must be organized simply;
- There have to be manufacturing areas which operate independently within the company and which are quasi-self organized;
- In the matter of developing software, we have to work with greater security and greater speed.

Leibinger believes that the whole idea of work has to be reexamined. Our workers have to find happiness again in their work. "We need more collegial spirit and fewer prophets," Leibinger, who has advanced the theory that we live in a split society, also asserted. This means that increasingly fewer people work. But the few who do work have to work ever harder to feed that large mass of people who do not work.

Dr. Vilser reported on the topic of production technology in the 21st century from the point of view of the small- and medium-size businessman. He believes that it is very important that the small- and medium-size entrepreneur be redefined. As a basis for this, the special organizational structure of the small and medium-size enterprise can be of help. To date, it has mostly been the number of workers and the turnover that served to delineate between small, medium, and large enterprises. By virtue of their organizational form, the small and medium companies are relatively more flexible. Historically, these smaller companies, many of which are located in Swabia, aim at directing their energies more to the product than to the market. In view of the international competition, this approach has to change. The traditional structures that developed in these enterprises, which today are still dominant chiefly because of tax considerations, will have to be reexamined if a positive development is to take place in future. It is Dr. Vilser's opinion that the small and medium-size businesses have not made full use of their strengths.

#### Interfaces Still Create Most of the Problems

Professor Kunerth's remarks, as the Siemens AG representative, were made from the point of view of a major company. He emphasized the point that there are still far too many interfaces between the various departments in the larger companies. It is Professor Kunerth's view that these interfaces are the source of most problems. He envisages the greatest changes taking place in the form of reexamining the effectiveness of cooperation between the various departments in a company. We can only meet the international challenge if we are prepared to make changes in our own enterprises. The humanizing efforts, which originated in the 1970s, have unfortunately fizzled out in the last 10 years. Efforts in the right direction, taken at that time, should be taken up anew. The question as to whether expensive production facilities should not be operating three shifts a day, seven days a week, must be considered. Societal and sociological changes are necessary.

Professor Warnecke presented his thoughts on the fractal factory. He noted that the German Federal Republic has lost ground in various fields of industrial development to other industrial states. In this regard, the positive side must be mentioned that 21 percent of all environmental technology used throughout the world comes from Germany. To be sure, this is still a very small market, but it will certainly expand in the coming years, especially in the 21st century. Professor Warnecke graphically described the relationship between industry and the market with the expression: "The customer has become a fast-moving target." Industry has to learn to react to the rapid market changes and especially to the very flexibly changing desires of the customer. He emphasized further that, despite serious considerations about lean production, automation must still be promoted in many industrial branches.

#### There are No Patent Remedies

None of the four panel members could provide patent remedies either in their presentations and/or in the discussion period that followed. In conclusion, it was acknowledged that Germany could only hope to meet the international challenge in the next century if the country was prepared to strive for enlightened policies. We must have the courage to commit ourselves again to industrial excellence and recognize industrial excellence as the measure for a positive future.

#### Austrian Robot Company Spokesman on Market, Strategy, Success

93WS03344 Landsberg ROBOTER in German Mar 93 pp 18-19

[Interview with Karlheinz Langner, managing director technology and development for IGM Robot Systems, by ROBOTER; place and date not given: "Lean in Vienna"]

[Text] With some 200 employees and a consolidated sales volume of nearly DM70 million in fiscal year 1991-1992, IGM Robot Systems is the most successful company in the Austrian robot industry. Its share of the market for the traditional robot applications, welding and cutting, comes to about 60 percent in Austria and 20 percent in Germany. Yet the company, with its home office in Neudorf, Vienna, does not appear on any rating list. This may be regarded as a personal tip. We spoke with Karlheinz Langner, the director of technology and development.

[ROBOTER] Mr. Langner, the current statistics for Austria indicate that, in terms of percentage, medium-sized companies use just as many robot systems as big companies. Where does this great acceptance come from?

[Langner] In Austria medium-sized companies are mostly suppliers for companies in Germany, as is the case with the automobile industry. That is, they set the example of how great an increase in efficiency sensible automation of production runs brings with it. With respect to this, the level of inhibition with regard to using robots for various applications is also relatively low.

[ROBOTER] But the idea of lean production is now circulating in Europe. What demands is this placing on the automation industry as far as new concepts and products are concerned?

[Langner] Fundamentally, nothing lies concealed behind lean production other than to organize the net product chain from the original idea to the finished product as quickly and effectively as possible. But, lean production will have to take on a different appearance in Europe than it does in the Far East. This is due to the fact that there is a surplus of well-trained skilled workers here, but an acute shortage of them there. This is why lean production in the Far East often means nothing more

than highly automated, unmanned production. The Japanese transplants in Singapore are the best example of this.

But in these parts what matters is effecting solidarity between man and machine. And since no company can be compared with any other one as concerns product range, versions and lot size number, technology, degree of automation, and equipment, etc., effective automation programs must be "tailored" to customers' specific needs. It's all the same whether this is done with or without robots.

**[ROBOTER]** What do IGM's lean automation programs look like?

**[Langner]** We've always oriented ourselves in cooperation with every customer to translate his wishes into reality in the most efficient way. It's our job to increase his ability to compete through our know-how and our products. The programs for achieving this are as diverse as the conditions just described for every individual customer are different from one another. Thus every one of our welding and cutting systems is unique since every user expects us to come up with a solution to his particular production problems. Let me cite an example of this: At Hyundai in Korea they weld doors for freight containers, at present still by hand, and the question was raised as to how this process could be automated within a predetermined investment and production time frame.

Right away several suppliers of systems technology—mainly from Japan—looked to us for solutions. While one of them wanted to provide the welding system with six robots, we were able to cut their number down to two. We were able to do this through a combination of simple linear axes in the handling of the workpiece as well as the overlapping of other operations. So you see, "lean" programs are also convincing manufacturers in connection with mass production, where highly automated systems are evidently the most efficient solution.

**[ROBOTER]** But lean production is having an effect on the robot systems themselves. There is a demand for reasonably cost-effective technical diversity.

**[Langner]** Our Modul Arc modular design system is a step in this direction. Another one is modularity. Everything can be accomplished with it, from linear components to flexible-arm robots with a variable number of axles to a complete system with 16 or more controlled axles for automatic welding. Furthermore, all the peripheral equipment like portals, pivot mountings, recording devices, etc., can be added on out of these standard components with uniform interfaces.

Another example: Everyone is talking about "universal controls." We have them. Developed on the basis of modules and transputers. Other suppliers' control programs can be superposed on them without losing their individual character. It is universally usable on the broadest basis to, for example, control machine tools or

material flow technology processes. There is already a number of very positive signs of this.

**[ROBOTER]** In October 1992 IGM took over the representation for Panasonic in Austria, Germany, and the former COMECON [Council for Mutual Economic Assistance] states. What do you expect to gain from this?

**[Langner]** Up until two or three years ago we were exclusively preoccupied with large systems for automation. The present economic downturn all over Europe naturally puts a damper on investments and calls for—not least under the sign of lean automation programs—simple and cost-effective solutions. And this has raised the question: Shall we develop these kinds of systems ourselves, or, where possible, cover the need for them with what is already available to us? Panasonic robots meet the performance requirements we have stipulated and are in the low-price range. So with them we will—as an alternative to IGM robots—equip our welding cells, ready for operation and for welding, for about DM120,000.

**[ROBOTER]** Will they continue to be "limited" to welding and cutting or is an expansion of their use to other applications imminent?

**[Langner]** Naturally, a robot application, welding, for example, cannot be viewed as detached from those operations that take place before and after it. It is a logical consequence that these processes be automated too. In this respect, we are complying even more than up to now with customers' wishes regarding this, customers who want to have handling and processing functions integrated into IGM systems in addition.

Furthermore, we're developing new applications in our traditional areas, for example, with the welding of aluminum or stainless steel.

Likewise, with the beveling of sheets of metal that are to be welded together. Conventional flame-cutting equipment is no longer sufficient for metal thicknesses of from 300 to 500 mm. For these kinds of processes special robot systems with appropriate sensors are really needed.

**[ROBOTER]** In Germany more and more users of robots and automation technology are demanding complete systems from a single source as well as better service and support from suppliers. How are you meeting these demands?

**[Langner]** We've already talked about programs and products. But we take a somewhat different view of "everything from a single source." We have a great production depth, regardless of whether drive units or controls, the aggregate of material flow components or the engineering is involved. Only in this way are we in a position to calculate system prices in a completely different way in the interest of the user and also to eliminate any system problems as quickly as possible on the spot.

Since we were just talking about money: Investors are at present considering—and very specifically—when and what they will spend money for. We will now also offer them leasing agreements for the financing of production automation systems. We install the system the customer wants ready for operation and he can immediately begin to produce efficiently.

**[ROBOTER]** After continuous annual growth rates of between 20 and 30 percent, IGM Corp. sales volume dropped by about 7 percent in fiscal year 1991-1992. What's the reason for this?

**[Langner]** The reasons why the consolidated sales volume amounted to only about DM70 million in fiscal year 1991-1992 are essentially the absence of orders from those markets that we had up until then more heavily supplied: the whole former USSR, England, and also Scandinavia.

Our current backlog of orders comes to nearly DM37 million. This will more than keep us fully occupied—a quite respectable achievement if we take a look at the situation the robot industry in Europe is in today. But if we compare this backlog of orders with the volumes of past years, satisfaction is out of place. At the present time there is no longer an annual growth in sales volume of from 20 to 30 percent.

**[ROBOTER]** IGM has a few branch offices abroad. What percentage of its total sales volume does the export business account for—specifically with your neighbor, Germany?

**[Langner]** Worldwide, our exports account for 90 to 95 percent of it. Nearly a fourth of that goes to fast-developing countries in the Far East. Although new robot applications are in less demand there, it is a market of the future with growth rates that none of us can yet imagine.

In Germany we obtain more than a third of our total sales volume through good management. We were just talking about volume of orders: Contrary to the general trend, we have a very good volume of orders from Germany; also now for new robot applications in interaction with large systems or applications in the low-end area.

**[ROBOTER]** With the exception of Hirata, up to now Japanese robot suppliers could only gain a foothold in Austria with difficulty. To what do you attribute this fact?

**[Langner]** There are two main reasons for this: First, there is the local proximity of the manufacturer demanded by users. Second, the customer wants a complete solution for the specific task, actually manufactured and delivered by the same source. The Japanese cannot now fully meet these conditions.

### France: New Robotics Laboratory Created

93WS0335E Paris *L'USINE NOUVELLE* in French  
25 Feb 93 p 40

[Text] The integrated automation research group and the University of Bordeaux's Automation, Shape Recognition, and Agricultural Robotics Laboratory have created the Automation and Computer-Integrated Manufacturing Laboratory (LAP). LAP's director Guy Doumengts guides its personnel of researchers, students, and foreign interns. Two research groups have been set up: the automation group, which is developing the methodologies for synthesizing commands; and the CIM group (GRAI), which specializes in modeling production systems, in simulation, and in shop control.

### Italy: Robotics Used in Long-Distance Surgery

93MI0378 Turin *MEDIA DUEMILA* in Italian Feb 93  
pp 74-75

[Article by Riccardo Panigada: "Surgeon Operates in Rome From His Office in Milan"]

[Text] The way is now open for surgeons to operate on patients who are tens, or even hundreds of thousands of kilometers away (bearing in mind that the colonization of space is just around the corner), while sitting comfortably behind their office desks. The first experiment in remote-controlled robotic surgery ever performed in the world, carried out during the latest "Rome Surgery" congress, proved to be a resounding success. The two operating teams that carried out the experiment were the team of Prof. Alberto Rovetta, professor of robotics and mechanical engineering at the Milan Polytechnic and "father" of the robot that performed the operation, and a team led by Prof. Licinio Angelini, holder of the chair in general surgery at the University of Rome. "Although in this instance we are talking about a simulated operation carried out on a dummy, we were still all holding our breath until we were sure of the outcome," said Rovetta. In fact, at a first glance, the synthetic material with characteristics identical to those of human skin did not even appear to have been cut. However, after zooming in on the site of the operation and making a personal inspection, the surgeons were able to appreciate the quality of the incision, which they defined as being a perfect example of a first stage incision. "As a result," continued Rovetta, "we are now getting ready to carry out the first experiment on a human being within the next few months."

But how is long-distance robotic surgery performed and in which cases could it prove to be advantageous?

The experiment we are talking about here was carried out with the remote-control station in Milan, and the receiving and operating station in Rome, with support from SIP [Italian State-Owned Telephone Company] administrative and operational headquarters in Rome and SIP operations in Milan.

The abdomen of the "patient" appeared on a monitor in Milan, where, by clicking the mouse, the surgeon was able to choose the site of the operation and the type of incision he wished to make. These commands were transmitted via modem to the remote-controlled mechanical arm in Rome.

This experiment has proven once and for all that it is now possible to eliminate the problem created by distance if a surgical operation should be necessary for example, on board a ship, or in an alpine refuge, or in the desert. Surgeons have shown themselves to be extremely enthusiastic about this technique and are urging the engineers to expand the robot's operating capabilities. They are equally interested in the possibility of performing routine long-distance operations on patients who have been injected with radioactive tracers. In this way they would protect their own bodies from continued and pointless exposure to radiation.

The next long-distance operation will be carried out on a human patient and will probably be a cruentous endoscopy. The robotic surgeon will perform the endoscopy by introducing into the patient a miniature TV camera connected to an optical-fiber cable, remote-controlled surgical tweezers, an aspirating probe, and a surgical probe used to facilitate exploration of the area concerned. In this case, the instruments will be introduced through four distinct surgical incisions.

The first experiment instead, was performed using three TV cameras: the first was positioned above the patient to select the coordinates for the point of incision on x-y axes, the second was situated laterally to ensure that the scalpel was positioned correctly at the point selected for the incision, while the third was used to produce enlarged images. The position of the robotic surgical arm the three cartesian axes controlled by a mouse and by a graduated scale visible on a window on the computer monitor.

Long-distance surgery has been possible since image digitalization cards, based on the use of the PC-Video type microprocessor, became available on the market. "We were then able to completely eliminate the difference between reality and virtuality," observed Rovetta. "In fact, in computer technology, it is possible to express the virtuality of a fact is its theoretical possibility, which can be compared and confirmed by actual reality. And while until now in human experience, the association of the two terms "real" and "virtual" in the expression "virtual reality" has indicated the expression of events and situations within the realms of the possible, now the reality experienced can be complete, depending only on the care and reliability with which the images are processed."

In fact, with the aid of a computer, the system provides images of the internal organs of the human body that can be processed to generate three-dimensional figures, which graphically reproduce the internal organs being examined.

A more detailed description of the experiment which was carried out is given below. This description makes it possible to appreciate the reliability and the robustness of the system.

In the operations station, the computer that receives the commands via modem, after having verified the absence of transmission errors, sends the input to the robot's controller by means of serial interface. The controller, after having in turn verified the correctness and the executability of the input received, transforms the input into movements of the operating arm.

The remote-control station operates using Toolbook software, designed for use with Windows. In this way a single terminal accommodates both the interface used to control the robot and the images received from the TV cameras (it is possible to select three video inputs from color TV cameras via the software). Soon software will be available to make it possible to effect modifications to certain parameters of the images, such as contrast, saturation, color content, and the scale factor, as well as being able to capture and memorize particular images.

The software has been designed to exclude any inconvenience caused by possible operating errors on the part of the remote controller. Additional robustness has been sought by programming requests for confirmation in the more critical stages and by limiting the operational possibilities of the system.

For example, once a movement command has been given, the program prevents any further commands from being given until the operating station signals the completion of the previously requested movement (although it is possible to cancel the given command). Synchronization between the remote-control station and operating station is guaranteed by the implementation of a two-directional communications protocol.

Work has already started on sensorizing the surgical robot, in order to give the whole system a further degree of intrinsic strength. But it is very likely that Prof. Rovetta, who in the late 1970s was the first to design a robot that obeyed voice commands, will have other surprises in store with his remote-controlled robot.

#### French Advanced Vision Robot Systems Described 93BR0419 Paris ELECTRONIQUE INTERNATIONALE HEBDO in French 11 Feb 93 p 28

[Article by Henri Pradenc: "The 'Seeing' Robot Will Find Industrial Applications"]

[Text] Prototype robots equipped with electronic vision systems are on the increase. Today the market is getting ready to take off.

Finding solutions based on standard components which will be economical and usable in industry is the aim which has governed the latest advances in the field of mobile robots. An example is the recent developments

by Pellenc, a manufacturer of agricultural machines. Its robot, designed for the automatic harvesting of fruit, will (at last!) be manufactured in series of several hundred as of 1995. The two-dimensional vision system developed by SAGEM [Company for General Electricity and Mechanics Applications] uses a CCD [charge coupled device] color camera with a 500x500 pixel matrix. The problems which arose were exposure to full sunlight—a question solved by the addition of an external flash synchronized with the sensing device—and the size of the camera—a problem which no longer arises now that the manufacturers separate the (optical) acquisition device from the processing section (which decodes the signal and converts it to the video standard). The latest trials, carried out last September, made it possible to achieve success rates in fruit detection in the order of 95 percent. The system needs less than 700 milliseconds to recognize the fruits to be picked and to give the robot the data it needs to develop a picking strategy according to the possible obstacles (branches and leaves). The sensors designed to steer the arm are standard ultrasound, infrared, or tactile components commonly used to trigger a limit switch (Polaroid, Honeywell).

Another example is the three-dimensional vision system developed by ITMI [Intelligent Machines Industry and Technology], which has received financial encouragement from the Research and Space Ministry. (In 1992, the Research and Technology Fund (FRT) allocated 16 million French francs [Fr] to work in the fields of robotics and computer-integrated manufacturing.) The aim was to develop a vision system which would allow a robot to move around by finding its own reference points in a changing environment. The system is comprised of two IEC 800-type CCD cameras from the I2S company, chosen because of their ability to supply high-contrast images. Processing is carried out by three electronic cards in VME [virtual machine environment] format mounted on the robot; the cards were produced by the image processing and shape recognition laboratory of the INPG [Grenoble National Polytechnic School]. At the end of the processing routine, the robot has three-dimensional data which enables it to work out its trajectory. The device acquires five images per second; this could go up to 10 images per second.

#### Tracking Trolley for the Factory Floor

"Our solution costs Fr200,000, while a laser imager would have cost between Fr700,000 and Fr1.5 million," explains Jean-Noel Soulier, an engineer in ITMI's technology transfer and development department. "It is true that a laser supplies more detailed data, but for a robot designed to work in an environment where regular geometric structures predominate, our system is perfectly suitable." ITMI's stereoscopic vision system could be used to make a trolley able to follow a human operator in order to carry loads on the factory floor. If it is sold to industry, the price they are aiming for would be less than Fr100,000.

For their part, laser imager manufacturers are making progress. LETI [Electronics and Computing Technology Laboratory] has developed the "Alis" sensor, which can take four images per second. Bertin is working on a low-cost laser range finder.

As for SAGEM, it is still looking for a low-cost gyrometer which will enable a more advanced version of the fruit-picker robot to find its direction without relying on material reference points.

#### German Institute Develops Machine Tool Diagnosis Procedure

93MI0458 Bonn DIE WELT in German 18 Mar 93 p 9

[Text] Engineers at the Fraunhofer Institute of Production Systems and Construction Engineering (IPK) Berlin have developed a new measurement and evaluation procedure for rapid fault diagnosis in machine tools. A portable personal computer measures current, voltage, and axle drive rotation speed within seconds without any additional sensors. The signals are picked up by the servo amplifier of the drive and digitized in the diagnostic computer.

Each signal taken by itself would only reveal major faults. When the data is combined, however, information about the physical condition of the machine can be obtained by means of a newly developed parameter-estimating procedure. The physical information is reprocessed with novel processes such as fuzzy logic and neural networks in order to identify the cause of the faults. Quality control and maintenance times can thus be reduced.

#### Netherlands: Dutch University Produces Mobile Robot

BR1404113093 Rijswijk POLYTECHNISCH WEEKBLAD in Dutch 2 Apr 93 p 1

[Article by Wim Raayen: "Twente University Creates First Mobile Robot—By Taking Another Trajectory, Smart Car Produces Shaver Instead of Mixer or a Coffee-Maker"]

[Text] Enschede—In just a few months, MART (Mobile Autonomous Robot Twente) will be moving around the University of Twente campus. MART is the first mobile manufacturing robot built by undergraduates and doctoral students from different technical disciplines. Twente leads the field in Europe, particularly in its interdisciplinary collaboration on mobile robots, according to project leader Professor M.P. Koster. He claims that the project can be compared with similar Japanese projects.

"The carriage already is finished," says Koster, professor of mechanical electronics. "Soon, the assembly robot will be ready, which will fit onto the chassis." Researchers in Twente also are working hard on the navigation system that will steer the robot.

Several faculties at the University of Twente have been collaborating on "the factory of the future" since 1990, within the context of the MART project. The work is being carried out at the Mechanical Electronics Research Center Twente (MCRT). Its ultimate goal is to develop a system for assembling small consumer articles, "such as shavers, mixers, or coffee makers," says Koster.

#### Shopping

The basic principle behind the system is its flexibility. Sometimes more mixers are needed and, at other times, more shavers. The Mechanical Electronics Center decided to produce a mobile robot to respond to this fluctuating demand. "In principle, it is a lot like shopping at a supermarket," says the professor, by way of comparison. The robot travels around the assembly hall, collecting components from various locations, known as "part supply stations." As it moves around, it fits the components together. To switch to making another product, it simply takes a different trajectory.

Complete freedom of movement for the robot is high on the Twente research team's list of priorities. The robot trajectory is not determined by rails, induction lines, or tracks. The layout of the production hall is preprogrammed into the robot's navigation system in the form of a mathematical model. This means that if the layout or the aisles in the hall are rearranged, the robot's mathematical model simply has to be reprogrammed.

#### Infrared Beacons

The central navigation system, which communicates with the robot via radio waves, determines the position of the machine as it moves around. It is not yet clear how this actually will be done. There are two possibilities: The first uses cameras fixed to the ceiling in a matrix. Each camera monitors part of the work space. Special marks on the floor are then used to determine the coordinates of each individually marked robot.

The other method, devised by Harry van der Schoot as his final year project, uses a rotating sensor attached to the robot and three fixed infrared beacons in the hall. The sensor calculates the angles between two pairs of the three beacons, from which the position of the robot can be worked out. Last week, the young engineering student won the Electronics Trophy for his idea. The trophy is a mechanical electronics prize for students which the Netherlands Branch Organization for Industrial Electronics awarded for the second time this year.

The central navigation system can steer several robots at once using the radio link. Their routes must take them past the right stations for the components they need, with a minimum of deviation. Each robot determines its own movements by counting the revolutions of its wheels (odometry) so that it can follow accurately the movement instructions given by the computer.

Collecting components for mixers or shavers requires even greater precision. The robot may have to pick up

tiny screws, which makes accurate position calculation and steering by the central computer a crucial factor. In addition, the system requires high-precision mechanical components.

#### Project Strength

The overall system's assembly requires a great deal of specialized knowledge from a wide range of technical disciplines. For example, the navigation system, the two servomotors which drive the machine, and the manipulator (the robot's arm) which assembles the products each require specific skills. "That is the strength of our project," says Prof. Koster. He is referring in particular to collaboration between electrical and mechanical engineers, mathematicians, and computer scientists. "Our multidisciplinary approach shows that it is possible for a group of undergraduates and a few doctoral students to develop an industrial robot."

Koster is full of praise for the MART research. "No other project in Europe has come this far with mobile robots."

In Japan, smart cars increasingly are being used to transport goods around warehouses, factories, supermarkets, and in dust-proof areas where chips are manufactured. Most of them are steered using conductive strips in the floor. However, Japanese researchers also are aiming at complete freedom of movement for their smart cars. With this in mind, several systems are being developed, including some based on computer systems combined with odometry or laser beams.

## MICROELECTRONICS

#### Bonn University Develops Powerful Microprocessor

93WS0359A Stuttgart *BILD DER WISSENSCHAFT*  
in German Mar 93 p 10

[Unattributed article: "Semiconductor Technology: BONA From Bonn"]

[Text] The highest-performing microprocessor in the world comes from Bonn: The BONA logic chip, which combines about 3.5 million transistors on a 2-square-centimeter surface was developed at the Bonn University Institute for Discrete Mathematics under the direction of Prof. Bernhard Korte.

The Bonn scientists have been collaborating with the computer producer, IBM, for five years. BONA is meant—as some of its predecessors already have been—to be built into the mainframe computers of the industrial giants. "It's really fascinating to compete with the Goliath of a worldwide concern like a little David," Korte commented on the success of his work. At IBM, too, they view their cooperation as positive. The cooperation agreement was recently indefinitely extended.

**FRG: Silicon-Germanium Layered Technique Developed**

*93WS0359B Stuttgart BILD DER WISSENSCHAFT in German Mar 93 pp 104-105*

[Article by Carola Hanisch: "Semiconductor Technology: Racetrack for Electrons"—first paragraph is BILD DER WISSENSCHAFT introduction]

[Text] Cheap, practical, but too sluggish—silicon is too slow for superfast computer chips. Artificial "high-speed racetracks" for electrons are expected to increase the circuit-switching speed.

Silicon has a number of advantages: There is a practically unlimited supply of it (in every grain of sand, for example) and it is therefore very cheap. Moreover, the original semiconductor is well-liked in the chip industry because it is simple to produce. But when it comes to speed, silicon is only a second choice. Since the mobility of the electrons is important for the speed of a semiconductor component. And it is clearly less with silicon than with toxic and expensive gallium arsenide.

A new technology, the modulation-doping of silicon-germanium layers, is now expected to eliminate this shortcoming. The new technique was developed by material researchers at the University of Ulm.

To make a semiconductor out of pure silicon, foreign atoms—antimony atoms, for example—have to be inserted into the silicon grid. These foreign atoms serve as electron donors and give the silicon its conductivity. But electron-doping also has its disadvantages: The foreigners get in the way of the electrons as they move through the silicon grid.

"You can think of it as a bowling alley all over which players are standing around. The players represent the antimony atoms and the bowling balls the electrons. The more players there are on the alley, the more often the balls hit them and are slowed down," Bernhard Hollaender of the Juelich Research Center explained. "With modulation-doping all the players are set up on pedestals and are no longer in the way of the balls."

The pedestals are in reality extremely thin layers of silicon-germanium mixed crystals in which the antimony atoms lie. The alleys consist of pure silicon. With this arrangement, they succeed in automatically guiding the electrons provided by the antimony atoms onto the antimony-free silicon layers, where they can flow unhindered. The trick works because the electronic potential of the silicon-germanium layer is higher than that of the pure silicon layer and that is why the electrons voluntarily move from the pedestals to the lower-lying alleys.

Until now, the question as to whether the mixed crystal layers would withstand the high temperatures that arise during the production of computer chips was unresolved. Released by the heat, a diffusion of the germanium into the pure silicon layers would bring pedestals and alleys to the same level—that would have been the effect.

However, they were able to dispel this doubt. Juelich researchers bombarded the silicon-germanium semiconductors with helium ions. They were able to conclude the assembly of the semiconductor on the basis of the speed of the ions that were scattered back. The layers withstood the test—therefore, a troublesome germanium diffusion at normal production temperatures could be ruled out.

The sandwich semiconductor might gain special importance if they were to one day succeed in combining a superconductor and a semiconductor on a single chip. This would be advantageous with, for example, magnetic field sensors, the so-called SQUIDS [superconducting quantum interference device], which operate only at very low temperatures. Since the electrons would no longer have enough energy at extremely cold temperatures to reach the higher-lying antimony atoms, their mobility at temperatures near absolute zero would not be impaired either.

**Philips Patents High-Capacity Erasable CD**

*93BR0412 Rijswijk POLYTECHNISCH WEEKBLAD in Dutch 12 Feb 93 p 3*

[Text] Eindhoven/Groningen—With the support of a research team from the State University of Groningen, Philips is working on an erasable, high-capacity CD. The technique, for which a patent application has been filed, should produce a marketable product before the end of the century, Dr. A.G.J. Staring of Philips Natlab says.

The preliminary work on the new storage technology in which bits are stored at the molecular level has been done by Dr. B. de Lange from the State University of Groningen. By using the molecular level for data storage, a huge packing density can be achieved.

All this is very promising, but if Philips wants its new technology to be a commercial winner, the company will have to stay ahead of the competition, Staring observes. Philips is not the only company that does research into methods for packing huge quantities of data on a small surface. The Japanese are very advanced in the field of magneto-optic storage methods, whereas AT&T's Bell Labs is experimenting with laser techniques which produce a capacity of seven gigabytes per square centimeter, 100 times as much as the present CD.

**Patent Application**

Meanwhile, Philips has applied for a patent in Europe, the United States, and Japan. "The European patent agency has concluded its investigation as to whether any existing inventions are constituting an obstacle to the granting of such a patent. No such obstacles were found. In the United States, the investigation is still under way," Staring says.

De Lange's method uses a light pulse to change an organic material's optical characteristics, more specifically the direction in which a polarized light beam is rotated. The material used, which is a chiral alkene, has two conditions: levorotating and dextrorotating. By

assigning value "0" to one condition and logical "1" to the other, digital information can be stored.

### French Electronics Firms Use Metal Injection Molding To Reduce Manufacturing Costs

93BR0418 Paris *ELECTRONIQUE INTERNATIONAHL HEBDO* in French 11 Feb 93 p 27

[Article by Laurence Mizrahi: "Injection Molding Reduces Price of Metal Cans by 30 percent"]

[Text] Metal injection molding (MIM) makes it possible to manufacture small items of complex shape at lower cost, which is very advantageous in electronics. The only constraint: production batches of at least 10,000 items per year.

"In the case of a small-size product which has a complicated shape, metal injection molding makes it possible to cut factory cost by 30 percent. This process should therefore be of interest to miniaturists and, in particular, the manufacturers of electronic systems," says Gildas Merian, the manager of Impac Technologie (a subsidiary of the Vallourec group), the first company in France to use this process. However, Gildas Merian stresses the fact that this technology is only profitable on batches of at least 10,000 items per year: "As in the case of plastic injection, the cost of the equipment must be amortized. A mold is worth between 100,000 and 300,000 French francs [Fr] and can be used on average for 300,000 injections. Therefore, the best cost/efficiency is reached on batches of approximately 50,000 to 100,000 items per year." This technology, which is now taking off in France, is apparently, according to the manager of Impac Technologie, already used in the United States and in Japan (at Hitachi Metal Precision, for example), mainly to make semiconductor packages, circuit packages with heat sinks, print heads, hard disk heads, contacts, pins, and also watch casings. IBM is using it in particular in one of its factories in the United States. Gildas Merian adds: "For all these applications where more and more functions must be integrated into an ever smaller space, the advantage of metal injection molding compared to the traditional methods (machining, drawing, electroerosion, etc.) is not only its lower cost; it also, and especially, makes it possible to increase the complexity at no extra cost, whereas this would economically not be possible using machining techniques, particularly for very small items. This explains why we are primarily working on products weighing between 1 and 40 grams."

Metal injection molding is in fact the result of the association of two well-known technologies, sintering and plastic injection. Like sintering, MIM uses pulverized metals to which an organic bonding agent is added. The mixture obtained has a viscosity close to that of plastics and can thus be injected equally well into a mold using a press. After the item is taken out of the mold, the bonding agent is eliminated either chemically (the item is plunged into a solvent) or thermally (the bonding agent vaporizes at relatively low temperatures in 20 to 30

hours). Final densification is carried out in vacuum or hydrogen furnaces. According to Gildas Merian, this process makes it possible to obtain items which have a density of very close to 99 percent, which gives them an obvious advantage over sintered items, which have a maximum density of 85 percent. Moreover, "the tolerances obtained being very accurate—in the order of 0.3 percent—finishing operations are generally not needed," he explains.

The company Egide, which specializes in producing metal semiconductor packages, is currently evaluating the method in its laboratories. However, according to Egide's sales manager, MIM would still give rise to a certain number of problems which would make it difficult to use, in spite of its real advantages in terms of cost: "The equipment is far too expensive; the shrinkage of approximately 15 percent which occurs when the bonding agent is eliminated is difficult to control, which gives rise to tolerance problems; finally, the degree of compactness of the items is not yet sufficient to guarantee the desired level of imperviousness."

### French Company Uses Cost-Efficient Thick-Film Technology

93BR0427 Paris *ELECTRONIQUE INTERNATIONAHL HEBDO* in French 25 Feb 93 p 21

[Article by Laurence Mizrahi: "Low-Temperature Cosintering Reduces Cost of Hybrid Circuits by 25 Percent"]

[Excerpts] Automated manufacturing technology used by the French company Sorep achieves high production outputs regardless of the circuit shape and number of layers.

With a view to expanding the range of its applications to the telecommunications, computer, and automotive markets, the company Sorep—a specialist in the manufacture of thick-film hybrid circuits—has moved headlong into low-temperature cosintering technology, which is 25 percent cheaper than conventional hybrid technologies. [passage omitted]

Low-temperature co-sintering technology made it possible to break free of all these problems since the substrate and dielectric screen printing paste are replaced by "raw" dielectric sheets treated one at a time. After punching the holes, each sheet is printed once to fill the vias and a second time to deposit the conductors. The sheets are then stacked, pressed, and sintered (at between 850 and 950°C) to achieve the multilayer product. As a result, there is no limit to the number of layers. Another advantage of this technology is that it halves the number of screen-print deposits. Using the conventional procedure, each conductive level is separated by at least two layers of dielectric paste each measuring 20 microns in thickness in order to achieve an acceptable spacing. With low-temperature co-sintering technology, it is enough to have one sheet—yielding an interspacing of 100 microns. This "simplification" of the procedure makes it

possible to obtain more reliable products—no matter how many layers there are—since these layers are independently prepared. The division of operations also makes it possible to automate the process, leading to savings of around 25 percent (depending on the quantity produced) and a good yield—no matter how many layers there are. Finally, since perforation and cutting are carried out before the circuit is sintered, i.e., when it is still “raw,” any hole shape (such as windows, for example) or circuit shape is possible. The smaller number of operations carried out on each sheet also makes it possible to work on both sides, thus producing double-sided circuits.

#### Problems at High Dissipation Levels

Compared to high-temperature co-sintered circuits, which are prepared in the same way but are sintered at between 1,200 and 1,700°C, the main advantage of low-temperature circuits is that they can use silver conductors, which are cheaper and perform better than the tungsten conductors found in high-temperature co-sintered circuits. Low-temperature sintering also causes less contraction and tighter tolerance levels: 12 percent in X and Y, and 17 percent in Z at approximately 0.2 percent, compared to 70 percent and approximately 1 percent in X and Y for high-temperature co-sintered circuits. However, whereas conventional hybrid circuits and high-temperature co-sintered circuits both use 96-percent aluminum oxide, low-temperature co-sintered circuits use a mixture containing 50 percent aluminum oxide and 50 percent glass, leading to a thermal conductivity which is five to eight times lower than that of 96-percent aluminum oxide. This can cause problems for use in applications with high dissipation levels.

#### [Box]

#### Sorep Teams Up With Specialists To Set Up Automated Low-Temperature Cosintering Line

The Brittany-based company Sorep has set itself the long-term goal of producing some 700 square meters of low-temperature co-sintered circuits per year in the 5x5-inch format. The circuits will comprise an average of six layers, with 100 vias per layer. To achieve this goal, Sorep has set up its own automated production line, “the first in Europe,” says Sorep CEO G. Dadou.

Most of the equipment was made by the Italian company Baccini, a specialist in thick-film manufacturing equipment.

More a partner than just a supplier, Baccini has adapted its conventional screen printing equipment to the needs of co-sintered circuits. Following perforation, the “raw” sheet is automatically placed (within a 10-micron range) and held by suction on the screen printing table so that the holes can be filled and the conductors deposited. These two operations take around 30 seconds per plate. The conductors and vias currently have the standard dimensions, i.e., 200 microns wide and 250 microns in diameter, “but our equipment makes it possible for us to

easily achieve 100 microns and 125 microns respectively,” says Michel Massiot, production line supervisor. The isostatic stacking and pressing of various screen printed sheets are also performed on equipment adapted specially for the job by the Italian company.

As for materials, especially the “raw” dielectric sheets, Sorep also has a partnership arrangement with Du Pont de Nemours. The chemical company, which created the process and developed the material, provides the dielectric material in the form of rolls which are cut into sheets measuring 6x6 inches (5x5 inches after sintering).

#### SGS-Thomson's 'Embedded Array' Circuits Described

93BR0431 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 4 Mar 93 p 18

[Article by Francoise Grosvalet: “Application-Specific Circuits: Advantages of Standard Cell and Gate Array Circuits Combined at Last”]

[Text] SGS-Thomson's line of dedicated gate array circuits combines the short design time of “sea-of-gates” circuits and the flexibility of use and optimization of standard cell circuits.

SGS-Thomson's recently introduced line of ISB28000 dedicated gate array circuits, also called “embedded array” circuits, combines on a single chip the advantages of gate-array “sea-of-gates” circuits (including fast and easy design) and those of standard cell circuits (optimization of the silicon surface used, complexity of functions that can be integrated on the chip, etc.). The circuits use 0.7-micron CMOS [complementary metal-oxide semiconductor] technology with three metallization levels and allow integration of 4,000 to 210,000 gates with a 250-picosecond gate propagation delay.

#### Custom Gate Array Circuits

The current line will be followed before the end of the year by the ISB35000 line, which will operate on a 3.3 volts and will make it possible to integrate on the chip any function from the company's catalog. The ISB35000 has been chosen as the technological vehicle for the 0.5-micron CMOS technology (three metallization levels) that will be adopted by all departments of SGS-Thomson. From a user's point of view, every member of the ISB28000 line appears as a gate array circuit, albeit a “custom” one, as it is the user who chooses the number of gates, the large blocks (memories, logic functions, I/O [input/output] peripherals), and the I/O cells he or she needs. The circuit is then manufactured by SGS-Thomson (chip size is determined by the number of I/O's) during the actual design process. In this respect, the user may take advantage of existing cell libraries for ISB24000 sea-of-gate arrays and CV22000 standard cell lines, by adding megacells derived from products offered by the company's various groups (such as RAMDAC's or DSP's [digital signal processor]). Libraries of specific blocks for telecommunications, data processing, and consumer electronics applications are still

being developed. Functions that may be integrated in the structure will include: single-port SRAM [static random access memory] up to 80 Kbits (2,800 bits per square millimeter with six transistors per bit) and double-port SRAM up to 64 Kbits (2,000 bits per millimeter with eight transistors per bit), with an access time ranging between 5 and 10 nanoseconds and a read/write time of between 8 and 15 nanoseconds; ROM [read only memory]; FIFO [first in, first out] buffers; multipliers and adders; as well as super-cells defined by their number of gates (core of the ST18932 DSP, DMA [direct memory access] controller-6,000 gates, bus controller-500 gates, etc.). Each device will also accept a number of peripheral functions (80-MHz 8-bit triple D/A [digital/analog] video converter and phase-locked loop (PLL), among others) and a maximum 400 I/O cells supporting the logic levels of EISA [Extended Industry Standard Architecture], ISA [Industry Standard Architecture], MCA [Micro Channel Architecture], and SCSI [Small Computer Systems Interface] buses. The user will also be able to choose between a 5-volt and a 3.3-volt power source (the device's core and inputs/outputs will be powered separately). SGS-Thomson offers a wide range of packages: PLCC [plastic leaded chip carrier] (up to 84 pins), Quad (up to 304 pins), and PGA [pin grid array] (up to 447 pins).

### Netherlands Project Develops Conductive Glues for Microbonding

93BR0448 Rijswijk *POLYTECHNISCH WEEKBLAD* in Dutch 19 Mar 93 p 1

[Article by Richard Hovers: "Environment Is Key Argument for Conductive Microglues"]

[Excerpts] Rijswijk—Fifteen companies are involved in a cooperative research project aimed at learning more about glues for microbonding. The Netherlands Institute for Welding Technology [NIL] is organizing the project, while Philips is serving as project leader. During a technology day on 30 March at the Electronics '93 trade fair, microglues had a chance to show off their advantages as an alternative to solder. However, some of the much vaunted advantages for the environment went up in smoke.

The Institute for Production and Logistics of the TNO [Netherlands Scientific and Technical Research Institute] has estimated that in the Netherlands some  $80 \times 10^9$  microbonds are made every year—a dizzying number of connections between components which measure less than a millimeter. The work is tedious and is usually handled by advanced machines in the precision mechanics and, especially, the electronics industries. Hence, Philips's role as project leader for the NIL research project in microglues, a three-year project that will run until 1996. Technically speaking, glues offer greater prospects than solders. The issue of environmental pollution plays a major role in the debate. [passage omitted]

### Technical Advantages

Glue has clear technical advantages, but for the most part reliable industrial applications are still far from developed. Dots of glue measuring less than 200 microns and layers of glue measuring less than 10 microns are more flexible than solder, which is especially important when substrate and component have different expansion coefficients.

In addition, materials can be used which cannot be soldered, such as conductive tracks of indium-tin oxides on LCDs [liquid crystal display] or polyester flexible films. Another advantage is that glue has a higher resolution capacity than solder. The metal particles in glue measure just a few microns, compared with a size of 50 microns in soldering flux.

### Sweden Develops High-Temperature Integrated Circuit

93BR0458 Paris *ELECTRONIQUE INTERNATIONAUX HEBDO* in French 25 Mar 93 p 22

[Unattributed article: "Industrial Application Perspectives for SOS [silicon-on-sapphire] Technology"]

[Excerpts] The Swedish company ABB [Asea Brown Boveri] Hafo will begin marketing in this year's second quarter a test circuit that integrates digital and analog functions on an insulating substrate and can operate at temperatures up to 250°C.

After GEC Plessey Semiconductors, which launched SOS (silicon-on-sapphire) gate-arrays integrating 700 to 37,000 gates in April 1992, ABB Hafo is preparing to market application-specific circuits based on this technology, whose advantages (heat resistance and reliability) are well-known. This widening of supply might lead to new applications for SOS technology, for example in automobile and industrial manufacturing; such applications would at last usher in the quantities needed to lower costs. Despite its numerous benefits, SOS technology is very expensive (since the substrate used is sapphire) and has, until now, been confined to low-volume applications in fields such as space, aeronautics, and weapon systems. However, the fact that it can operate at a 250°C temperature makes it an almost ideal technology for many other applications such as engine control. Furthermore, this technology makes it possible to integrate signal processing functions on the same substrate as sensors and actuators. With a view to achieving such applications, the Swedish company ABB Hafo has been preparing a library of SOS-based standard cell circuits operating at temperatures up to 250°C, a technology originally developed for space applications. A test circuit integrating digital and analog functions for signal preprocessing in a sensor should be available in the second half of 1993. [passage omitted]

**Tested During 2,000-Hours at 210°C**

Apart from the cost, which according to ABB Hafo will never be less than twice that of traditional semiconductors, the main drawbacks of SOS technology lie in higher noise and leakage current levels than in CMOS [complementary metal-oxide semiconductors] devices. However, according to ABB Hafo, these two parameters do not impair the performance of digital functions. And while they must be taken into consideration in the design of analog functions, these drawbacks are more than made up for by SOS circuits' heat resistance and insensitivity to radiation. Moreover, their intrinsic galvanic insulation properties also make it possible to integrate functions using different voltages on a single chip.

**Essen University Presents Nanometer-Sized Electronic Switch**

93MI0476 Bonn *DIE WELT* (WELT Report insert) in German 24 Mar 93 p WR6

[Text] The smallest electronic switches, such as those found on microchips, do not even approach the size of a speck of dust. But miniaturization has still not reached its limits—microelectronics engineers the world over are hoping for even smaller ones. A decisive step has now been taken by scientists in the Inorganic Chemistry Department of Essen University. At the CeBit fair, professors Guenter Schmid (chemical synthesis) and Guenter Schoen (electronic properties) are presenting an ultimate miniaturization principle jointly developed in working parties: pairs of tiny tailor-made gold particle surrounded by a protective sheath, between which individual electrons can be "switched to and fro." These "clusters" measure just one nanometer (one millionth of a millimeter); each pair consists of 2 x 55 gold atoms and has semiconductor properties.

**Germany: Hannover University Presents High-Power Video Chip**

93MI0477 Bonn *DIE WELT* (WELT Report insert) in German 24 Mar 93 p WR4

[Text] High-power chips for tomorrow's video technology, a simulation program for making accurate network calculations of power supply systems on a personal computer, and information on environment law at the touch of a key are being exhibited by Hannover University at CeBit. Taking part in the computer trade fair are the Institute of Law Information Science, the Institute of Electricity Supply, and the Information Technology Laboratory.

The Information Technology Laboratory is presenting the high-power AXP 640 V chip for the first time in Hannover; it can be used in all areas of video technology. This video signal processor has been designed to meet future demands, too. The chip is composed of a RISC [reduced instruction set computer] processor and a coprocessor. The current computing capacity of the coprocessor is 640 million operations per second in the chip and 40 million instructions in the programmable

RISC processor. The chip is ready for use in future multiprocessor systems, and the computing capacity can be expanded many times over without difficulty. [passage omitted]

**German University Develops Prototype 40-GHz Transistor**

93MI0482 Bonn *WISSENSCHAFT WIRTSCHAFT POLITIK* in German 17 Mar 93 p 4

[Text] Electrical engineers in Bochum have now achieved a maximum operating frequency (cutoff frequency) of 40 GHz with a prototype heterobipolar transistor.

The transistor, which was developed with the proven base material silicon, will now become even faster, and be refined and improved until it is suitable for use in very high-speed integrated circuits, for which only very cost-intensive semiconductor materials such as gallium arsenide (GaAs) had been considered to date. A total of 2.06 million German marks [DM] has been granted to Professors Berthold Bosch and Hans-Ulrich Schreiber (Department of Electronic Components, Faculty of Electrical Engineering at the Ruhr University, Bochum) for materials and personnel for the project out of the Federal Ministry of Research and Technology (BMFT) "Nanoelectronics" program.

The silicon/silicon-germanium (Si/SiGe)-based "very high speed Heterobipolar transistors and integrated circuits" research project is scheduled to run until mid-1995 and will be carried out by the Bochum-based scientists in collaboration with the other partners receiving funding: Ilmenau Technical University the Daimler-Benz Research Institute in Ulm, and the SEL-Alcatel Research Center, Stuttgart.

**Cheap Silicon Can Be Fast Too**

The fact that silicon, long considered outmoded because it is allegedly too slow, is an inexpensive base material that still has potential for substantial increases in performance has been proved time and again by the scientists in Bochum. The silicon-based heterobipolar transistor is an electronic semiconductor material. It constitutes an abrupt transition from the silicon material to the silicon-germanium compound. This heterojunction is situated between the transistor zones known as emitter and base. The interplay makes for current amplification, the end result being improved high-frequency performance of integrated circuits, which in turn brings higher operating speeds.

**France: SGS-Thomson Starts Testing T9000 Transputer Prototype**

BR1404113793 Paris *ELECTRONIQUE INTERNATIONAL HEBDO* in French 1 Apr 93 p 37

[Francoise Grosvallet: "Parallel Computing Gets Its Formula-One Engine"]

[Text] More than a year later than planned, SGS-Thomson finally is issuing samples of its T9000 transputer, a unique, top-level-performance 32-bit microprocessor, unrivaled for interprocessor communications.

"Admittedly a little bit behind the original schedule, it is, however, among the best machines at the moment," says Philippe Geyres, vice-president and director of Inmos, the programmable products division of SGS-Thomson, which has just begun deliveries of the first samples of its second-generation transputer, the T9000. With 3.3 million transistors on a 10 mm x 20 mm chip using 0.8-micron CMOS [complementary metal-oxide semiconductor] technology and a capacity of 200 Mips (millions of instructions per second) and 25 Mflops (millions of floating point operations per second) at 50 MHz, the T9000 certainly is one of the most complex and powerful microprocessors on the market today (by way of comparison, the Pentium integrates 3.1 million transistors and has a theoretical calculating power of 112 Mips; the Alpha from DEC reaches 400 Mips at 150 MHz). This makes the T9000 truly a unique microprocessor.

#### Ten Million Transistors for 64-bit Version

Neither CISC [complete instruction set computer] nor RISC [reduced instruction set computer] (most statistical organizations place it in the RISC classification, where it ranked third in worldwide sales in 1992), the transputer owes its originality to its four serial communications links (at 100 Mbit/s for the T9000) which make it an exceptional device capable of performing parallel calculation. Neither supercomputer manufacturers (particularly European ones) nor mail sorting specialists were wrong, by the way: They already have been using transputers from preceding generations (T800) and are impatiently awaiting the T9000. This is true particularly of the German company Parsytec, which announced the first desktop supercomputer at the official T9000 presentation conference in London on 26 March (unfortunately without any price indication). SGS-Thomson's ambition is to double its transputer sales within the next two years (\$40 million in 1992). This implies that the transputer no longer will be confined to its "major niche" market, but nevertheless will remain a "niche."

#### Microcontrollers Market in Sight

For all that, P. Geyres does not wish to compete with Intel: "There are two large markets for microprocessors, PCs and dedicated control applications, but the first one is closed because processors have to be Intel-compatible to find a position." Consequently, SGS-Thomson has chosen to attack the second market, which is the reason why it is launching a development program for future generations of transputers (particularly 64 bits) under the name Chameleon, as well as a program called RMC for creating modular blocks permitting the rapid development (three to six months compared to one year at present) of transputer-based microcontrollers (which should sell for \$10 to \$20, while the sampling cost of the T9000 amounts to \$695).

The Chameleon program, long known by its code name E1, is intended to develop a 64-bit transputer integrating over 10 million transistors by 1996, in the context of the European OMI (Open Microprocessor Systems Initiative) program. To this end, the program develops generic modules performing a variety of functions (cache memory and 64-bit processor, programmable communications processor, ultra-high-speed communications links and link routers, floating point coprocessor, reconfigurable coprocessor) which can be used alone or together and can even be integrated onto a single chip in the required configuration. The Chameleon program components are to be manufactured in 0.50-0.35-micron technology already in production at the company's factory at Crolles. This is the factory that should be producing the T9000 by the end of the year. Dedicated modules, such as the ATM [asynchronous transfer mode] communications processor and an image processor, also are planned, because SGS-Thomson intends to tackle the telecommunications market, among others, to lift its transputer out of its present market niche. The first Chameleon modules should be introduced in 1996 or, as P. Geyres remarks, "with a three-year gap between two generations, which is a completely normal gap in the microprocessor industry, particularly as we are anticipating a 100-percent gain in performance for the T9000 simply as a result of upgrading from present technology to 0.5-micron technology."

The other program the company is relying on to extend the market for its transputer has been given the code name RMC. It involves developing modules supported by the present T400 and T9000 transputer architectures. SGS-Thomson is aiming directly at the microcontroller market with this program and is setting two priorities: telecommunications and particularly ATM for the creation of line interfaces, and computers for links between PCs and hard disks. The latter involves using the serial interfaces from the transputer to replace the present parallel interface, which limits the possibilities of miniaturization for hard disks. The RMC program is intended to develop transputer core modules, interfaces, and bus modules in 0.5-micron CMOS technology. It also will be possible to retrieve the functions in the company's various libraries of specific circuits.

#### France: Electronics Firm Uses Inexpensive Gold-Plating Method

*BR2004100893 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 1 Apr 93 p 40*

[Article by Laurence Mizrahi: "Gold-Plated Conductors Become Accessible to All"]

[Text] Thanks to the automation of their gold-plating line, the Ateliers de Ballancourt [Ballancourt Workshops] can produce gold-plated conductors for the same price as tin-plated tracks.

Involved in gold technology since 1989, the process developed by Ateliers de Ballancourt has now resulted in

the establishment of a fully automated gold-plating line capable of handling up to 1,000 square meters of printed circuits a month. These gold-plated printed circuits will not cost more than tin-plated ones.

Ateliers de Ballancourt specializes in the manufacture of medium-sized batches of single- and double-sided printed circuits with plated-through holes (it achieved 26 million French francs [Fr] in revenues in this area in 1992). It can from now on choose between selective tin plating or gold plating and market them under identical industrial conditions.

Until now, Ateliers de Ballancourt produced their gold-plated printed circuits on an "experimental" line, which generated Fr4 million in revenues in 1992. This allowed them to perfect their gold-plating process, which comprises two steps: a nickel-plating operation (5-micron-thick deposit) and a 0.1-micron-thick gold-plating operation (called the "Cute" process). The thinness of the gold layer minimizes the risks of pollution emanating from the dip solder bath and of "brittle" joints, which for a long time gave a bad name to gold-plated printed circuits. As a matter of fact, to step up the processing speed, Ateliers de Ballancourt initially envisaged using a chemical process for the nickel deposits, but they finally opted for the plating method so as to avoid the 90°C dip solder bath, which is likely to lead to etching flaws. The problem of the speed of the process was solved by robotizing the line: Each printed board passes the gold-plating line in less than seven minutes. As far as the deposit's quality is concerned, Ateliers de Ballancourt claims it can optimally control the plating parameters (current density, for example), permitting them to obtain an even gold-plate unaffected by the negative effects of power surges.

According to Mondher Khanfir, technical director of Ateliers de Ballancourt, the gold-plated printed circuits are primarily targeting users who cannot do without gold: surface mounting specialists and manufacturers of channel selector switches in which gold-on-gold contact zones are found.

"Until now, most surface-mounting specialists in Europe buy their printed circuits in Southeast Asia, due to the lack of competitive manufacturers in Europe. We think that the production capacity of our gold-plating line will enable us to take 10 percent of the national market (Fr15 million in 1992) and achieve about 25 percent of our sales in this area. As for selector switch manufacturers, who prefer mixed boards, i.e., tin-plated ones except for the contact zones, they will now discover the economic advantages of full gold-plated boards."

Mr. Khanfir also hopes to find customers among those who until now chose tin-plating. "The gold-plated printed circuits, which lend themselves as well to wave soldering and reflow soldering as tin-plated circuits, boast a number of additional advantages," he explained. "Above all, unlike tin-plated boards, they statistically

present very few outgassing phenomena at the plated-through holes during wave soldering; thus, the burn-in phase becomes optional. Second, if the components are clean, they can do without fluxing. Finally, the circuits can be stored for more than a year, which cannot be done with tin-plated circuits."

## NUCLEAR R&D

### France Launches Phebus Nuclear Reactor Research Program

93WS0325A Paris AFP SCIENCES in French  
4 Mar 93 p 29

[Unattributed article: "Phebus Reactor To Go Back on Line for Testing After Three-Year Shutdown"]

[Text] Paris—After a three-year shutdown, the Phebus nuclear research reactor, located at Cadarache (Bouches-du-Rhone Department), has just diverged in preparation for three months of testing, the Nuclear Protection and Safety Institute (IPSN) announced in a 2 March press release.

According to the press release, IPSN will be using the facility through 1998 for a research program, Phebus PF [Fission Products], on the behavior of fission products in a nuclear reactor in the event of a serious accident.

The program has required major changes in Phebus, as well as the construction of an experimental pressurized-water reactor. Following on the first hot tests of the experimental loops, completed in recent weeks, this first divergence "constitutes an important step in the startup test campaign, which should end with the first experiment before summer," IPSN says. Thereafter, the Phebus PF program will proceed at the pace of one experiment a year.

IPSN has received considerable cofinancing to carry out this project, which has an expected total budget of 900 million French francs [Fr]: EDF [French Power Company] (25 percent of costs), the Commission of the European Communities (30 percent), and 15 percent from several foreign participants (Japan, the United States, South Korea, and Canada).

### CEA Develops Superconducting Cable for Tokamaks

93WS0325B Paris AFP SCIENCES in French 4 Mar 93  
pp 29, 30

[Unattributed article: "Superconducting Cable for the Next Generation of Tokamaks"]

[Text] Paris—The Department of Controlled Fusion Research (Directorate of Physical Sciences, CEA [Atomic Energy Commission]) has designed and developed a niobium-tin superconducting cable at the Cadarache center in the context of the European fusion technology program, a 25 February CEA press release

reports. The cable will be used for the magnetic field coils on the next generation of Tokamaks.

This cable, which can operate under heavy loads (40,000 amperes) in 12-Tesla magnetic fields at temperatures of -269°C, consists of an assembly of 864 conductors, each composed of 4,000 superconducting filaments. According to the press release, it "is perfectly suited for the high-field superconducting coils of the future International Thermonuclear Experimental Reactor (ITER)."

Several domestic and foreign companies were involved in its development: Trefimetaux and Vallourec (France), Teledyne Wah Chang (United States), and Dourmetal (Belgium).

The first series of tests, conducted by the Euratom-CEA Association using Institut Suisse Paul-Scherrer's SULTAN test bed, recently confirmed the material's superconductivity under nominal operating conditions. It also demonstrated a safety margin at 2°K, which would make it possible to operate the ITER under nominal conditions without fear of a sudden loss of superconductivity.

CEA is also pursuing the development of highly heat-resistant materials for use in the future ITER thermonuclear reactor. At the CEA-Framatome test station in Le Creusot, a continuous 47 MW/m<sup>3</sup> heat flow, obtained by electron canon bombardment, has been evacuated using a device made of a hardened copper alloy that can withstand heat flows comparable to those at the surface of the sun.

These two achievements come in the context of the agreement on the detailed engineering study for the future ITER, signed 21 July 1992 in Washington by Russia, Japan, the United States, and Europe. The purpose of the agreement is to provide the technical prerequisites for the construction of the reactor.

#### Germany: Expert Systems Developed to Monitor Particle Accelerator Efficiency

93MI0413 Munich SUEDDEUTSCHE ZEITUNG  
in German 4 Mar 93 p 40

[Article by Olivia Meyer: "Artificial Intelligence in the Accelerator—New Approaches Needed to Evaluate Millions of Collisions Between Elementary Particles"]

[Excerpts] [Passage omitted] Scientists at Wuppertal University have developed an expert system that quickly tracks down technical faults in the "Delphi" detector at LEP [European Large Electron Positron Storage Ring] during data collection, preventing valuable acceleration time being wasted. Because the experts who built the detector's various counters are not always there when they are needed, it is a good idea to record their specialist knowledge in an expert system. A diagnostics system like that at Wuppertal frequently finds many problems even faster than the physicists.

Neural networks in particular are increasingly being used in particle physics. Such networks consist of a large number of units working in parallel, arranged in several layers like the human brain and therefore also called "neurons" or "nodes." The chief characteristic of neural networks is their ability to learn. In a "training stage" they practice giving as correct as possible output data for every input pattern. The networks can then quickly recognize patterns similar to those they have learned.

High-energy physicists are up against pattern recognition problems every day. When particle beams collide in the big circular accelerators, the released energy changes into a large number—sometimes hundreds—of particles of different kinds, directions and energies.

"Neural networks are ideal for making a quick preselection of the data, separating the wheat from the chaff, so to speak," says physicist Karl-Heinz Becks from Wuppertal. First of all, the events must be filtered out of the jumble of "background events." For example, one of the elementary particles circulating in the ring often collides with a gas module that has remained in the beam tube despite the high vacuum. Such impacts in fact occur 1,000 to 10,000 times more often than "genuine" collisions. In HERA [Hadron-Electron Ring], for example, this process produces a data rate of half a million events a second, which is too many to cope with. To reduce this to about 100 a second, an electronic circuit—the "trigger"—must decide within a few microseconds whether an event will be stored on magnetic tape or not. To keep up with the breakneck speed, the trigger must process the information from the various detector components simultaneously. Neural networks, whose nodes are processors working in parallel, are particularly suitable for this. Several triggers with neural network architecture are currently being installed on two detectors at the Tevatron to look for a variety of events.

Hungarian physicist Pal Ribarics of the Werner Heisenberg Institute for Physics in Munich is also working on a "neural network trigger" for the HERA H1 detector. It will consist of 10 modules of four chips each, which in turn have four identical parallel processors.

They will be trained with typical sample events generated by so-called "Monte Carlo" programs. These give a realistic simulation of the physical processes at a collision.

Apart from recording and preprocessing data, neural networks are also used to classify events so as to understand, for example, what physical process has led to a particular observed "final condition." For example, when electrons and their antiparticles (positrons) collide in the LEP accelerator, pairs of elementary building blocks, that is quark-antiquark pairs, are almost always produced. Five different types of quark—up, down, strange, charm, and bottom—have so far been found, and the search is on for the sixth, the top quark. Quark cannot be easily observed, because they "shatter" or fragment immediately as they are created into a large

number of particles that bunch into so-called "jets." So it is not easy to determine what type of quark is involved in any particular event.

It is now the task of analysis to discover the fine differences between a jet from a light quark and one from a heavy bottom quark. The width of the bunches and their energy, for example, give valuable indications of their origin. Physicists have already had some success here with neural networks. For example, a team led by Karl-Heinz Becks has shown that a network can identify bottom quark jets just as well or even better than conventional methods. Neural networks are also being used with the Tevatron, the accelerator with the highest energies to date, to find the top quark.

#### Nature as Model

The Wuppertal physicists believe that event analysis can be improved decisively by a further process copied from nature, the "genetic algorithms." From an initially random number of solutions, pairing (recombination) and mixing (crossover), and occasional mutations, gradually produce new generations, only the best of which—according to the Darwinian principle of selection in evolution—are ever accepted.

The scientists are using the genetic calculation method to reconstruct in detail the particle cascade produced by the fragmentation of the quarks. They are also working on "hybrid" methods linking neural networks, expert systems and genetic algorithms. For example, the structure of neural networks can be optimized with genetic algorithms, while expert rules can already greatly reduce the number of solutions that have to be investigated.

## TELECOMMUNICATIONS

### Telekom's Expanded Use of Fiber Optics Examined

93WS0310A Stuttgart *BILD DER WISSENSCHAFT*  
in German Mar 93 pp 81-84

[Article by Richard Sietmann: "Setting the Course for the Future: 1993 Is the Year of Decision for Fiberoptics Transmission"]

[Text] German industry has strengthened its international lead in the new Federal States by constructing a completely new telecommunications network. But fiberglass-cable home hook-ups are still in the distant future.

It would be difficult to find another investment program to match it. The German Federal Post Office's Telekom wants to invest 60 billion German marks [DM] in the new federal states in the period from 1990 to 1996. The reason cited for this ambitious program is the conviction that the more than 7 million new telephone hook-ups and 2 million cable TV hook-ups will catapult telecommunications in eastern Germany right up to the level in the West by the mid-1990s. This bold undertaking involves the entire infrastructure from establishing the cable system to the

introduction of modern digital exchanges. This unusual exercise in grand planning is proving to be more than just advantageous. The pressure to satisfy the eastern states' strong demand to catch up as quickly as possible with the West has forced Telekom to resort to the tried and true old copper cable for most of the connections. Today, almost all experts in the field insist that the copper lines will in no way be able to cover the telecommunications demands of the coming generations.

Copper cable—the double core cable for the telephone and so-called coaxial cable for cable TV—are considered a bottleneck for any new services as, for example, the high-resolution TV (HDTV) or the call-up of video transmissions. In order to function at all, even video-phone and videoconference transmissions require lines with a greater data-handling ability than copper cable can provide. The current ISDN data rate of 64 kilobit per second already exhausts the transmission capacity of the telephone lines. In order to provide television quality videoconferences, a 70 to 140 megabit per second capacity—more than a thousand-fold greater than currently offered—is required.

Unfortunately, when the planning and reconstruction project got underway in the new federal states in 1990, the future-oriented optical hook-up systems were not yet available on the market.

Telekom now faces the dilemma that the newly constructed transmission lines in the eastern states is really being built with an already obsolete cable technology.

In the early 1980s, the German Federal Post Office and the six producers—SEL, Siemens, Tekade, Felten & Guillaume, AEG Telefunken, and Fuba—were tops in international development. In 1983, 10 experimental networks for 28 to 48 glass-fiber single connections had been set up within the framework of the Bigfon Project for a "wide-band integrated glass-fiber communications system." The test program, in which 68 of a total of 320 participants were able to enjoy videtelephony, ran until the end of 1986.

Bigfon technology was designed as a service for the general public. It aimed at the new, future-oriented opportunities of the so-called integrated wide band net, in which, in the enlightened opinion of the world's leading telephone companies, both the dialogue services (telephone and today's ISDN), videotelephony) as well as the distribution services (cable TV) would in future be combined at the local network level and transmitted via fiber optics.

The project partners had admittedly ventured too far with Bigfon. Frank Sporleder, associated with Telekom's research center in Darmstadt, summarized the results of the field test: "Much too expensive, and no demand." He added an afterthought: "Even in the technical sense, everything looks rather different today." The result was that Bigfon technology was not developed further. Moreover, even test systems that were operating well, in the opinion of Telekom engineers, were taken out of service.

Horrendous costs brought about Bigfon technology's bitter end. A single connection had cost far more than a million DM. Using copper technology, on the other hand, Telekom put the average cost at DM700 per cable TV hook-up and DM1500 for a telephone connection. Immediately before Germany's reunification, in the late 1980s, the wisdom was that fiber optics systems would only become attractive cost-wise for both customers and Telekom in the mid-1990s.

Nevertheless, Telekom bravely went ahead and expanded its fiber optics network. The company has to date laid 1.7 million fiber kilometers, predominantly in the telecommunications system, but partially also in local communications lines between local exchange centers. Home hook-ups were almost always put in with traditional copper technology.

In view of the gigantic reconstruction program in the East, pilot projects were undertaken in fiber optics in Windesheim in 1990. The cooperative venture, involving the producers Raynet GmbH, Alcatel SEL, Siemens, Bosch Telecom and the Fast consortium made up of AEG, ANT, and PKI, were to arrive at conclusions with respect to implementation reliability, and cost-effectiveness.

Based on seven projects, called Opal (optical connections), Telekom ordered 226,000 fiber optics connections for 1993 at a total cost of DM480 million; they were to be installed chiefly in Berlin, Leipzig, Dresden, Chemnitz, Magdeburg, and Schwerin. In allotting contracts, Telekom set the condition that the finished system should cost no more than an equivalent system using copper technology, i.e., not more than DM2200 per hook-up.

In the next two years, Telekom wants to install another 500,000 Opal systems. If this is accomplished, every sixth telephone in the new federal states could be called up via fiber optics. For industry, these contracts mean a significant beginning in cost-saving of mass produced optoelectronic components.

It was not the cost of fiber optics materials that in the past impeded the development of this modern technology, but rather the exorbitantly expensive connection modules. Fiber optics lines cost 40 to 70 pfennigs per meter and are more expensive than telephone wire, which cost seven pfennigs a meter. On the other hand, they are considerably cheaper than the coaxial cable used for television, for which Telekom has to shell out two and one-half marks per meter.

The decisive cost factor in fiber optics technology are the optoelectronic circuits. Transmitting and receiving chips, which convert the electrical bits into digital light pulses and vice versa, are required at both ends of the fiber optics line. The semiconductor lasers and photodiodes that can do this are complicated and expensive components from solid-state electronics, which can only be produced at an acceptable price when produced in very high numbers.

The result was that a typical chicken-and-egg problem presented itself.

- because optoelectronic components are so expensive, there has been no noteworthy demand for them to date;
- because there is no market demand, the producers of optoelectronic components cannot manufacture them cheaply.

Consequently, system operators like Telekom are waiting for favorable bids, while the companies are waiting for large, cost-reducing orders. The million connections now ordered by Telekom should resolve the problem once and for all.

For the time being, nothing will change for the normal TV and telephone service subscriber. The fiber only goes as far as the cable boxes on the street or, in the case of larger buildings, to the building hook-up. The fiberglass plug in the dwelling is now the target, but the telephones and TV sets cannot yet operate on the light pulses from the line.

Only after the requisite end products reach the market can Telekom lay the last meter of cable with fiberglass.

Telekom engineers expect another beneficial efficiency effect by changing the net structure. Presently, the lines from the local exchanges to the subscriber are, on average, two kilometers long. Since fiber optics signals can be transmitted without loss, the distances between exchanges and subscribers can be increased to 10, even 20 kilometers. As a consequence, fewer exchange centers will be needed. Moreover, they need not be situated in the heart of a city or town any longer, but can be erected on more economical real estate in the suburbs.

The potential savings that would be realized in the case of cable television is even more drastic. In that field, the almost loss-free optical transmission would eliminate the need for many line amplifiers currently required for practically each 200 meters of copper cable in order to compensate for line and splitting losses. Fiber optics would change that. Thanks to modern optical amplifiers, there is no longer a need to have active, current-supplied elements between the exchange center and the subscriber hook-up. Passive optical nets, known in the technical jargon simple as Pon(s), will suffice.

A laboratory experiment conducted by British Telecom demonstrates the capabilities of such systems. The British researchers showed how 40 million TV subscribers could be provided with 384 TV programs with only two amplifier stages in the transmission center and the local exchange center. Some 95,045 connections were kept in operation by the last amplifier. Even, as is the case, when an optical amplifier today costs DM40,000, the splitting ratio achieved quickly results in cost-effective hook-ups.

This optical amplifier is a remarkable example of the dynamic developments in optoelectronics. In 1987, scientists at Southampton University in Great Britain demonstrated for the first time that optical signals, as they pass through the fiber, can be amplified just as in a laser if a piece of fiberglass is deliberately "contaminated" (dosed) with erbium atoms. The first commercial prototypes were able to appear on the market scarcely four years later.

Optoelectronics is to telecommunications, what microelectronics is to computers, namely, a key technology. But, unlike the situation with microelectronic chips, where Japanese and U.S. companies dominate the international competition, telecommunications is one of the few growth industries in which European and German companies have a leading position worldwide.

Consequently, even the world's greatest network operator and system producer—the U.S. AT&T Company—is very attentively studying just how German Telekom, together with its supplier industries, is building further on its know-how advantage. "Germany will certainly be an international leader in the introduction of fiber optics in local systems," asserted Herwig Kogelnik, one of the leading engineers at AT&T Bell Laboratories, at the recent European Conference on Optical Communications. And that can be considered a real compliment.

#### Chances Seen for Scandinavian HDTV System

93WS0322A Stockholm NY TEKNIK in Swedish  
11 Feb 93 p 5

[Article by Staffan Dahllof and Miki Agerberg: "High-Definition TV Will Be Digital"—first three paragraphs are NY TEKNIK introduction]

[Text] HD-Divine, the Nordic digital TV system, could make a breakthrough now that the EC's emphasis on analog high-definition TV is faltering.

"The important thing is to move quickly. The field is open to new players," said Per Appelquist of Swedish Television.

But in order to succeed, the Nordic proposal needs the support of a TV manufacturer.

A cooperative effort by the Nordic telecommunications agencies and Swedish television may influence the formation of an entirely new TV technology in Europe.

This will happen when the air goes out of the EC's billion-kronor investment in analog high-definition TV (HD-MAC). Several signs indicate that the investment of EC prestige in high-definition TV is coming to an end.

- Philips halted plans to manufacture receivers for analog HDTV. "It is meaningless to manufacture sets if the EC does not fund programs for the new technology," a Philips spokesman in Eindhoven said.

- EC industrial commissioner Martin Bangemann hinted that the commission is considering changing its TV strategy.
- Denmark, which is currently acting as EC chairman, is drawing up such a change of course for a decision at a meeting of cabinet ministers in May. A controversial appropriation for new TV programs costing the equivalent of 4 billion Swedish kronor will either be put on ice or divided up between both analog and digital HDTV research.

This strengthens repeated criticism of the analog system, which was developed by the electronic giants, Philips of Holland and Thomson of France, with the participation of Finland's Nokia. The future of analog high-definition TV has run out before the technology has even come on the market.

Thomson is officially continuing to proclaim its faith in HD-MAC and does not intend to halt development work. But the company does not want to miss the digital train either.

Last week Thomson concluded a strategic agreement with a U.S. firm, Compression Labs, Incorporated (CLI), which specializes in digital image compression. Thomson is investing 100 million kronor in CLI so the companies can work together to develop products for the digital HDTV market.

"The EC has failed," said Per Appelquist, development chief of Swedish Television and representative of HD-Divine, a Nordic cooperative project that will now become an independent company.

HD-Divine showed last July that ground-transmitted digital TV works in practice. The technology is based on compressing digital signals (NY TEKNIK 1991:38). They can then be transmitted over the regular ground network without taking up more space than a traditional TV channel.

The next step for the Nordic HD-Divine is to seek support for the digital standards they believe in themselves. This will involve new system battles with major players.

Japanese and American digital technology is far advanced. Both Thomson and Philips participate in technology development in the United States. But the two flagships of the European electronics industry will not receive dividends from their analog HDTV technology before digital TV makes a real breakthrough.

In this perspective it is not enough to advocate "correct" solutions. In order for them to have an impact industrial support is needed.

"We would like to have the backing of a hardware manufacturer," said Per Appelquist of HD-Divine.

Is there room for a reborn Swedish TV industry?

"It may be a little early, but we are interested in cooperating with manufacturers, preferably with a Nordic base."

**Picture Caption**

1. p 5: The Nordic HDTV system: 1,200 million bits per second (1.2 gigabits/s) flow from the high-definition TV camera. After filtering and coding the speed of the picture signal has been slowed to 27 megabits/s and the transmitter sends it into the ether at that speed. When it reaches the receiver the carrier waves are demodulated and put together to form the original signal, which creates the picture the TV viewer sees on the screen.

**EC Abandons D2-MAC Standard, Keeps 16/9 Format**

93WS0324A Paris AFP SCIENCES in French  
26 Feb 93 pp 9, 10

[Article: "HDTV: Europeans Appear Resigned to Change of Course"]

[Text] Paris—Under pressure by the British, the television chains, and the advances in digital television being made in the United States, the Brussels authorities and European TV set manufacturers appear to have resigned themselves to revising their plan for developing high-definition TV. This change of course has been in the air for several months. It finally materialized last week with the statements of the European commissioner for industry and telecommunications, Mr. Martin Bangemann.

Mr. Bangemann stated that the television chains would not be compelled to adopt the European D2-MAC broadcast system, essentially an analog system that until now has been considered a necessary intermediate step toward European high-definition TV. The essential thing now, he said, will be to promote broadcasts designed for the new wide-screen television sets (16/9 format), which are closer to the movie-screen format than the traditional "square" screens (4/3) format, thus paving the way for other transmission systems, including all-digital systems currently in the experimental stage.

Neither the Dutch Philips group nor the French Thomson group, the two European manufacturers of TV sets that have invested the most in the D2-MAC standard over the past five years, criticized the statements. They even stated, for their part, that they could work just as well with an all-digital system as with D2-MAC.

The French government, though one of the most ardent pro-D2-MAC militants, also did not contest this "refocus" of the European position. The view from Paris is that this should convince the British while preserving "the essential": the Thomson and Philips investments in 16/9 television sets. Paris adds that it hopes the "Twelve" will ratify this shift of focus before May, by

modifying the "plan of action" prepared last year in support of European HDTV.

This plan, blocked by London in December, called for allocating several hundred million ECUs—the figure being mentioned today is around 500 million—to chains broadcasting programs in the 16/9 format and conforming to the D2-MAC standard.

The "revised" plan is expected to provide for allocating these funds to programming in the 16/9 format regardless of the broadcasting system used. The 12 ministers will probably also call for better coordination of European research on digital systems, and might decide to increase the subsidies being accorded to them, currently amounting to several tens of millions of ECUs, according to French government sources.

Research is "scattered," according to a French Parliament report. France, Germany, and the Scandinavian countries are each conducting research on digital HDTV in national research centers, while participating in Community projects.

Philips and Thomson are conducting their own research in Europe, but to an even greater extent in the United States, where they are involved in the race to develop a terrestrial transmission standard for digital TV, on which the Federal Communications Commission (FCC) will have the final say. The FCC hopes to find a digital standard by 1994, making large-scale digital broadcasting possible by 1998, it says.

The manufacturers point out, however, that even if an American standard is defined rapidly, it will not be usable in Europe without modifications because of large-scale differences in transmission conditions here. Moreover, in the opinion of some French experts, that standard will fall far short of meeting the objectives set by the European Community with respect to improving the definition of the television image, leading these experts to conclude that the primary consequence of this European shift of focus will be to delay until after the year 2000 the bringing of true "high definition" into the homes of the televiwers.

**EC Abandons HD-MAC Standard**

93WS0335D Paris L'USINE NOUVELLE in French  
25 Feb 93 p 40

[Text] The EC has shifted its rifle to the other shoulder and asked European manufacturers to work on a digital television standard. Martin Bangemann, the European industry commissioner, has just dealt the final blow to the HD-MAC analog standard, for which the Europeans fought by investing over 10 billion French francs [Fr] during the last seven years. Is this a bow to realism, since the Americans have already opted for a digital standard? In any event, the Europeans will have to handle the thorny problem of the dependence of 16/9 format sets on D2-MAC.

**Philips Develops ISDN Coding Technology**

93WS0356B Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 26 Feb 93 p 8

[Unattributed article: "Video Conference Becomes More Mobile and Less Expensive: Philips Develops Special Coding Technology for Image and Sound Signals"]

[Text] Frankfurt—The company Philips Kommunikations Industrie AG, Nuremberg, has developed a coding technology with which video conferences can be transmitted less expensively using the ISDN [Integrated Services Digital Network]. To that end, the transmission bandwidth is divided between image and sound differently than with videophone. As Philips reports, there is a transmission rate of 112 kilobits per second available for the image and a rate of 16 kilobits per second for the sound.

The cost advantage over a standard video conference with transmission rates of, respectively, 140 kilobits and 2 megabits per second is considerable. While a one-hour conference between Paris and Nuremberg with a broadband connection costs each party 1,200 German marks [DM], the total fees with the ISDN are DM138. If the conference takes place after 1800 or on the weekend, the costs drop to only DM103, Philips estimates.

Moreover, automatic dialing is possible for national and international video communication with the ISDN. In this way, both the time and length can be specified by the parties themselves. They are not dependent on the reserved times.

Philips has developed the mobile VKE 70 and VKE 140 devices for this type of conferencing. Because of the picture-in-a-picture technology, only one monitor is necessary, where all the visual signals from the transmitting, receiving, and document camera pertaining to the conference can be seen. The video conference system can be set up anywhere that there is an ISDN connection.

The company is testing this moving image communication technology at five sites in France, two in the Netherlands, and one each in Germany, England, Spain, and Belgium for internal communication.

**Siemens Official on Telecommunications Sales, Prospects**

93WS0379A Duesseldorf HANDELSBLATT in German 26-27 Mar 93 p 29

[Article by wt: "Board Member Baur Demands Fair Competition in the Telecommunications Markets"]

[Text] "German Telekom is a latecomer to international business and must now take care not to lose ground." In the opinion of Dr. Hans Baur, a member of the central board of directors of Siemens AG, Berlin/Munich, the globalization of competition in the telephone companies results in "the same cutthroat competition that we have

known in the manufacturing market for a long time." Baur's conclusion: "Not all the established telecommunications companies in Europe will survive."

The new competitors of the classic telephone companies are new customers for industry, to be sure. But these companies buy their systems and equipment primarily where the price-performance ratio is balanced. Baur complained that there are still distortions in competition in various markets, even in Europe. He therefore demanded a "limited but decisive industrial policy, which assures fair competitive conditions in the transitional period from monopoly to open market."

In Hanover, the Siemens board of directors pointed out the exceptional significance of microelectronics and optical data transmission for the progress of telecommunications. The integration density in microelectronics has thus increased 4,000 times within 20 years. At the same time costs have dropped to 1/2,000th of the original price. In the other core area, optical electronics, the transmission capability through fiber optics cable has increased 400 times in 13 years. Over the same period, however, the costs dropped to one 1/600th of the initial amount.

On the one hand, these two developments have accelerated the expansion of digital technology in telecommunications. According to Baur's information, half of all public switchboards and about 80 percent of all transmission facilities have been digitized today. On the other hand, they have laid the foundation for innovations such as mobile telephone and broadband data networks.

The "black sheep of the basic technologies," as Baur describes it, is the software, whose share in the overall development costs for systems and equipment has risen to about 75 percent. It has not been possible so far to increase the productivity of software significantly. The doubling of the productivity previously achieved over periods of five to 10 years "is too slow compared to the hardware development."

Siemens's business in the field of public communications networks and private communications systems reflects the difficult economic situation right now in the most important markets. Siemens board member Dr. Erwin Hardt thus expects only a slight increase in sales in the 1992/93 business year from 13.2 German marks [DM] to DM13.8 (+5 percent). For incoming orders the chairman of the management of the public communications network division anticipates a volume of DM14 billion.

In Asia, Siemens was able to increase the pace in all growth markets, according to its own information. Hardt described China as the key country. In the past five months Siemens received orders there for approximately 1.4 million connections with electronic dialing system technology. Further, a joint venture company was founded in China to sell and manufacture mobile radio base stations and telephones according to the European digital GSM [Special Mobile Group] standard.

Siemens is also able to sell increasingly more private communications systems in Asia. Thus, the Hicom private branch exchanges are now being marketed in the ASEAN nations of Indonesia, Malaysia, the Philippines, Singapore, Thailand and Brunei. And equipment from its U.S. subsidiary Rolm is being offered in the Tiger nations of Hong Kong, South Korea and Taiwan as well as Japan. "We want to at least triple our business volume in the Pacific area in the next few years and be one of the leading suppliers," Peter Pribilla, chairman of the divisional management for private communications systems states his goal.

He stressed that in the private network sector Siemens "is well in the black worldwide and that will not change this year either." On the other hand, the U.S. market is difficult, which "still affects the overall result." However, the light at the end of the tunnel has already brightened somewhat. Extensive reorganization and productivity projects at Rolm are having their effect, Pribilla explained.

In the current 1992/93 business year the number of incoming orders worldwide have clearly increased over the previous year. In 1991/92 it grew by 5 percent to DM5.2 billion. Pribilla referred particularly to the telephone activities which Siemens-Nixdorf-Informationssysteme AG took over and the full inclusion of Rolm. He assumes that sales and new orders will reach DM6 billion each by the key date of 30 September. Last year the turnover increased by 5 percent to DM5.4 billion.

**German Telecom Innovation Program Summarized**  
**93MI0395 Munich SUEDDEUTSCHE ZEITUNG**  
*in German 27-28 Feb 93 p 21*

[Article by Walter Ludsteck: "New Face of Telecommunications: Innovations Will Bring Growth"]

[Text] Around a century after the birth of the telephone, telecommunications is making a quantum leap. Voice and data networks are growing; capacity and transmission rates are multiplying; videophones are coming; networks' intelligence is leading to new services; and mobile phones are providing mobile communication. At the same time, competition is heightening, there is a global market, and company concentration is increasing.

Though forecasts differ widely, experts agree that telecommunications are one of the markets of the future, in not the market of the future, with growth rates forecast for Germany as for the rest of the world. Development will be driven both by technology and by customer demand.

Four innovations are pointing the technological way ahead:

- Digitalization of all types of information enables joint transmission over a single network;

- Computers enable processing and storage of these data in the network;
- Optical fibers enormously increase transmission potential, and also provide room for new services;
- Mobile phones are bringing universal accessibility.

Together these trends form the basis for the future integrated communication network, providing high-speed digital transmission of voice, text, data and images (including moving ones) in large quantities, together with a wide range of applications. A single broadband universal network, the ISDN (Integrated Services Digital Network), will thus replace both today's analog telephone network and existing specialized data networks.

**Universal and Intelligent**

Digitalization of information transmission and switching started many years ago in Germany. The complete replacement of analog technology, however, will not be completed until well after the year 2000. For four years the Federal Post Office's Telekom has been connecting a digital ISDN network based on conventional telephone lines. Though the potential of this narrow-band ISDN is limited by the telephone lines twin-core copper cable, it does already make possible the transmission of different types of information over a single network.

According to Telekom director Gerd Tenzer, the ISDN service will cover the whole of the older laender by the end of this year, extending to east Germany two years later. So far, however, the service only meets German standards, though network operators in 20 European countries have now agreed to introduce a common Euro-ISDN standard by the end of 1993.

Telecommunication networks will be not only universal, but also intelligent. Computerization gives the present analog telephone network an additional digital architecture, enabling information to be stored and processed in the network.

In April, Telekom plans to introduce four new services based on the Intelligent Network (IN) over a wide area, enabling, for example, calls to be automatically diverted to the caller's nearest office, using a call number which is standard for the whole of Germany.

Computer intelligence is particularly important in so-called virtual networks, where the customer has his or her own tailor-made network, consisting not of specific dedicated lines, but set up by the network's computer according to the customer's specific requirements. Another part of the vision for the future is a service, to be known as Centrex, which will even make it possible for the network operator to function as a private branch exchange.

The third innovative stimulus is provided by optical fiber technology. This provides enormous expansion of network capacity: A single optical fiber, thinner than a human hair can already simultaneously handle 30,000

telephone calls. This massive transmission capacity meets the requirements for the goal of a broadband ISDN network.

The Federal Post Office's Telekom has long been installing optical fibers on trunk lines. There also exist a large number of local networks integrated into a precursor of a broadband network. Seven pilot projects, known as Opal, are currently trailing domestic optical fiber connections. In parallel, an experiment (Berkom) has for some years been running in Berlin, involving equipment and applications running on the basis of the new ATM (Asynchronous Transfer Mode) broadband transmission and switching principle. Building on this, Telekom plans to introduce the first broadband ISDN services in Berlin, Hamburg, Cologne and Bonn, in 1994.

Such telecommunications freeways are also being built across the whole of Europe. Together with Italy, France, Britain and Spain, Telekom is developing the Global European Network, providing an optical fiber-based high speed link between national networks, introduction of which could start this spring. GEN will be replaced around 1995 by an even more powerful pan-European network called METRAN (Managed European Transmission Network). The next phase has already been launched through the so-called Euro-ATM Project. The architecture of a "European Telecommunications Community," providing such services as an integrated emergency call system, is, in Tenzer's words, "clearly taking shape."

Mobile phones are also giving a new dimension—that of virtually universal accessibility—to telecommunications. In addition to the analog C Network, Germany has two other networks, D1 and D2, operating, based on the European GSM standard. A third digital network, E1, using a different frequency as a PCN (Personal Communication Network) system, has just been licensed. Use of GSM mobile phones in particular could well spread throughout Europe within a few years. In addition, satellite mobile phone services are planned, providing information transmission anywhere in the world.

Experts believe that the multiplicity of innovations, together with increasing electronic links between companies, could lead to the growth rate in the telecommunications market doubling that of the economy as a whole over the next few years. For the period to 1995, Telekom is expecting the increase in revenue from business clients to double that from private clients, with the proportion of revenue from business users (presently 44-percent) outstripping that for private users in the foreseeable future.

Telekom director Dieter Gallist states that growth of Telekom's services will be particularly driven by the strong demand in the mobile phone, ISDN and client-specific company network markets. For example, the number of mobile phone connections could pass the

million mark during the first quarter of this year, while 2.8 million subscribers are expected by 1994, and 10 million by the year 2000. For all that, Telekom fears that mobile phones could reduce revenue from the line-connected telephone network, which could also suffer from the expected growth in use of company data networks: Telekom estimates these losses to amount to around 5-percent of annual revenue from line-connected telephones by 1995.

#### Films by Cable

Interest in ISDN services is growing, after a slow start. Though by the end of 1992, Telekom had connected only 268,000 base lines, its figures suggest that the market is growing by over 300 percent per year, and it hopes to have achieved a million connections by 1995. Telekom is currently trailing new ISDN applications with over 60 companies, with such facilities as remote maintenance of machines, transmission of medical photographs (e.g., computer tomography), and electronic image transmission from photographic archives supplementing such familiar services as telephone, videophone, fax, data transmission and video-conferencing. Possible future applications include individual retrieval of feature films from a library for domestic viewing, multimedia applications or telecommuting from home.

With data transmission services, Telekom feels the trend lies towards individually tailored international company networks for major clients. Telekom's figures show the revenues for its relatively new package of services, "Datannetz" [data network] to be rising by over 100 percent per year. In contrast, such standard services as Datex-P are now growing more slowly.

#### "Only The Major Players Survive"

These new technologies mean higher R&D costs combined with ever shorter innovation cycles for network operators. At the same time, national markets are becoming increasingly open, and competition is acquiring a global dimension. Even such major companies as Telekom, however, are not in a position to impose international standards on their own. This requires alliances, which in Telekom's view will lead to increasing concentration in the telecommunications business: Gallist forecasts that "only the large, global players will survive."

If Telekom is to be believed, a golden age is about to begin for customers, who will enjoy better, faster and greater choice of services, with ever-lower transmission charges and equipment costs. Hopes of lower telephone or telecommunications bills are misplaced, however, as the general tendency towards lower prices is bound to be more than offset by increased use of the wider range of services, and by costly specialized services. Also, as personal contact is reduced, for example through video-conferencing or telecommuting, the greater will be the demand for telecommunications. The industry has good reason to see itself as a growth area.

**Eastern Germany Receives Advanced Telecom Network**

93M10467 Bonn *WISSENSCHAFT WIRTSCHAFT POLITIK* in German 10 Mar 93 p 4

[Text] In the new laender in particular, new network structures will give an additional boost to the dynamic developments in the telecommunications sector. One of the most modern fiber optics networks in the world is being created there.

It is called "Opal" (from the German for "optical line"), and more than 200,000 homes and businesses will be connected this year alone. From 1994, another 500,000 lines will be connected every year. Other measures, like the VISYON (variable intelligent synchronous optical networks) project, are also helping to achieve the "fiber to the home" target as quickly as possible.

The current VISYON pilot schemes offer business customers services with transmission capacities of 64 kilobits to 155 Megabits per second. Data reduction immediately makes it possible to transmit studio-quality digitized HDTV [high definition television] images on these lines, as Telekom recently demonstrated in Munich.

"Fast data communications networks will spread quickly and be profitable," claims Professor Rolf Kreibich of the Berlin Institute of Futurology and Technology Appraisal (IZT) confidently.

**Intercompatibility**

The industry's watchword is worldwide connectivity; be it to transmit postscript files from the set to the lighting

studio, decentralized document processing by geographically remote administrative offices, multimedia applications where the contents of teaching centers are distributed to study centers or end users, the trend is for network notes, which are currently linked bilaterally, to be linked up into one single universal network.

"The EC Open Network Provision directives—so to speak the open frontiers of European telecommunications—must be adopted to smooth the way for the development of Europe-wide services so that service suppliers can use networks in the various Member States with uniform access principles and procedures," Gerd Tenzer, Telekom's network engineering director, said recently. "The aim will be to foresee the pace in the creation of trans-European networks as a means of strengthening economic and social cohesion in Europe by linking national networks together and rendering them interoperable in open, competitive markets."

**Rapid Growth in ISDN**

Rapid strides are also being made in expanding ISDN [integrated services digital network]. Hardly two months into the year, the number of lines had shot up again. The Integrated Services Digital Network already has 660,000 logic lines; as compared with 620,000 at the end of last year. Some 160,000 business customers opted for the "basic access" with two logic channels, and just under 12,000 opted for those with 30 "exchange lines." The market is booming and since about the middle of last year the connection curve has been pointing steeply upwards.

## AEROSPACE

**Brazil: Alcantara Base Launch Plans**

93SM0217Z Sao Paulo *GAZETA MERCANTIL*  
in Portuguese 2 Apr 93 p 13

[Article by correspondent Mariluce Moura]

[Text] Alcantara—The Alcantara Launch Center (CLA) in Maranhao State, which this morning in the presence of President Itamar Franco will launch the VS-40 rocket 1,396 km into space, weather permitting, is preparing to garner, before the year is out, its first foreign financial returns from the investment made in building the base that has cost about \$130 million so far.

This comes about because agreement already has been reached with NASA (only the signature of the formal contracts is pending) to launch 12 scientific sounding rockets and 20 meteorological sounding rockets, all belonging to the U.S. space agency, from Alcantara between October and December of this year. The market price of this service—providing a launch base—is approximately \$1.5 million for each sounding rocket.

So Alcantara will not only make it feasible for Brazil to control the launch phase of the rockets and satellites it is beginning to produce, but to fulfill the part of the All-Brazilian Space Mission (MECB) that seems to have the best chance of giving Brazil a certain degree of competitiveness in this area of the space industry.

President Itamar Franco pointed out yesterday during his visit to the CLA that Alcantara has certain comparative advantages over other launch sites for small rockets and satellites. "The fact that it is located two degrees south of the equator permits a fuel economy of 25 percent, compared with normal consumption, and its proximity to the sea increases launch safety," he said.

**Magnetic Equator**

Fabio Jose Vieira de Souza, an engineer, is operations director of the Alcantara Launch Center and will command today's launch of the VS-40. He provided some more technical details to explain why the Alcantara base is of interest to NASA and other space agencies. "Although the geographic equator is only two degrees away from Alcantara, the magnetic equator is even closer," he said.

This means the electromagnetic belt that circles the earth at its center passes very close to the CLA. This permits scientific probes of the ionosphere, the layer above the atmosphere, a feat not achieved by rockets launched from any other existing base.

"The Americans had been setting up their own facility for these probes in Peru, where there is no base. Since we have one that is almost ready, we offer undeniable comparative advantages," Souza explained.

**Future of the Atmosphere**

Research in the ionosphere enables man to forecast phenomena that will occur in the atmosphere some years

from now. "For example, there are projections concerning the hole in the ozone layer that cannot yet be done in the atmosphere, but can be made by investigating the ionosphere," the engineer said.

The Alcantara Launch Center, which celebrated its 11th anniversary yesterday, occupies an area of 620 sq km. The older Brazilian center, Hell's Gate [Barreira do Inferno] in Natal, takes up only 18 sq km. Approximately \$200 million would be needed to completely finish the base, according to Minister of Science and Technology Jose Israel Vargas, a member of the presidential delegation.

However, only about \$38 million would be required to ready the center to launch the VLS, the satellite launch vehicle, the vital component of the All-Brazilian Space Mission that was supposed to have been used to launch the SCD-1 data collection satellite. That satellite was sent into space this past February aboard a U.S. Pegasus rocket owned by Orbital Science.

Vargas summed up the question of the Brazilian space program as regards the MECB this way: "The program was expected to cost \$900,000 to \$1.1 billion over a 10-year period. We had only \$500,000 available to spend, in 12 years." Development of the SCD-1 cost \$150 million, and another \$350 million were consumed between the Alcantara Base and the VLS. "We need to spend another \$400 million, of which \$50 to \$60 million should be used this year to complete the VLS and go forward with the Alcantara center."

These funds are not in the aeronautics ministry budget. Yesterday, President Itamar Franco promised to study ways to get those resources. He suggested that privatization of state corporations may be one source of money for the priority area of science and technology.

**Final Step for the VLS**

|The VS-40, scheduled to be launched today as part of an operation that has been dubbed "Santa Maria," is a two-stage rocket that is considered to be the final step in the conception of the Satellite Launch Vehicle (VLS) being built at the Ministry of Aeronautics' Space Activities Institute (IAE) in Sao Jose dos Campos. The VLS has now been in development for 12 years; its construction has been delayed both by funding problems and by the difficulty in obtaining certain sensitive foreign technologies that it needs—which means the IAE has had to depend on national capabilities.

The device that, weather permitting, will go into space today and, like a sort of prototype, give a hint as to how the VLS will perform, is 9.4 meters long, weighs 6,612 kg with its payload (solar sensors used to capture data from a data collection satellite), and has a diameter of about 1 meter.

It achieves a maximum speed of 4,544 m/second, and its two stages will be burned up in 152 seconds, during which time the rocket will have attained an altitude of 1,396 km.

The entire operation, which will be witnessed by the President of the Republic and some of his cabinet ministers, will be finished when the VS-40 falls into the sea at a distance of 2,080 km from the launch center. During that short space of time, the technicians at the CLA command center will have monitored such components as the remote control and locator systems, the equipment in the telemetry system, the connection between modules, and the pyrotechnic systems in the fourth stage of the VLS.

#### Brazil: Civilian Space Agency Proposed; VS-40 Launch

93SM0218Z Sao Paulo GAZETA MERCANTIL  
in Portuguese 3-5 Apr 93 p 9

[Article by Mariluce Moura: "Itamar in Alcantara Proposes Establishment of Civilian Agency for Space Program"]

[Text] Alcantara—President Itamar Franco announced on Friday, shortly after attending the successful launching of the VS-40 rocket at the base in Alcantara, Maranhao, that he would submit an urgent bill to the National Congress for establishing the Brazilian Space Agency. Itamar Franco added that he had instructed the ministers of aeronautics and of science and technology and the president of the Brazilian Commission for Space Activities (Cobae) to complete studies for that purpose as quickly as possible.

The agency will be a civilian agency responsible directly to the president of the republic. And according to the official note regarding his decision, which he made it a point to read at the airport serving the Alcantara Launch Center before departing for Teresina, Itamar Franco hopes that establishment of the agency will lead to a "greater coordination of effort among the industrial, scientific, and academic communities" in connection with the Brazilian space program.

The president did not provide any information, however, about the source of the funds needed for establishing the agency or continuing the All-Brazilian Space Mission (MECB), which will require about \$50 million this year in order to complete the Satellite Launch Vehicle (VLS)—the VS-40 rocket is the forerunner of the VLS—and finish construction of the Alcantara Launch Center (CLA) facilities that are essential for the scheduled launching of the VLS in 1995.

"We have no budget revenues, but the president, stirred by the success of the "Santa Maria" operation, which he has just attended, is determined to find solutions that will enable us to stick to the timetable," said General Lelio Viana Lobo, minister of aeronautics.

In his note concerning the space agency, the president himself showed enthusiasm, saying that "Brazilian space activities are reaching a new stage of development thanks to the successful launching of the VS-40, which is the forerunner of the VLS; the operation in orbit of the

SCD-1 satellite, which was produced entirely in Brazil; and our country's increasing presence in the international arena of space exploration."

#### Slight Differences

The launching of the VS-40 could be observed from the terrace of the CLA Technology Center 7,000 meters away. The picture of the rising rocket could be seen for only three seconds, after which it was covered by heavy clouds.

The minister of aeronautics said that with some slight differences, the VS-40 performed within the parameters established in its design and in simulations. For instance, its expected apogee, or highest altitude, was 1,396 km, and it reached an actual altitude of 987 km. The fuel burn time in both stages was as expected—that is, two minutes 32 seconds.

Flight time was 1,138 seconds, or just over 18 minutes, compared to the planned time of 24 minutes. And the VS-40 fell into the sea off the coast of Rio Grande do Norte about 2,500 km from its launch point—in other words, it traveled farther than the 2,080 km originally planned.

#### Angles and Winds

The minister of aeronautics explained that those minor differences were "certainly due to problems with launch angles and winds, which affect the flight of a ballistic device being guided from the launch base."

Air Force Colonel Carlos Augusto Cavalcanti, commanding officer of the CLA, who with the VS-40 was completing his 97th launch operation, said that the differences which are observed in a preliminary rocket and which therefore serve to guide the construction of the VLS are essential in a piece of equipment that is being tested.

The cost of the "Santa Maria" operation and the expenditures specific to the VS-40 were not revealed. They are included in the overall figures for the VLS, which has cost about \$230 million so far.

The minister of aeronautics announced that the Alcantara Launch Center had completed about 60 percent of the project. The launching of the VLS is now awaiting only "a greater refinement of all its systems and the completion of a few activities."

Once that is complete, it will be used to launch not only the VLS but also other low-orbiting sounding rockets for NASA and probably Russian rockets as well. Talks are already under way with the Lockheed firm of the United States and with the Russian firm Krunichev Enterprise. In addition, there are agreements at a more advanced stage with NASA for using Alcantara as the launch base for 32 sounding rockets (including 20 meteorological rockets) between October and December of this year.

But looking farther into the future, plans also call for using the base as the launch site for high-orbiting rockets, according to the minister of aeronautics.

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